Mount Lemmon Service Area Watershed Study and Wastewater Management Plan

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EXECUTIVE SUMMARY

In 2003, the Aspen Fire resulted in a large percentage of lost structures in the community of Summerhaven on Mount Lemmon. As the community recovers from the fire and begins redevelopment, future wastewater management is an important consideration. On May 18, 2004 Pima County residents passed a sewer bond package for the Mount Lemmon Wastewater Treatment Facility. The $7.2 million bond was funded to provide improvement and expansion options for the Mount Lemmon Wastewater Treatment Facility (WWTF), collection system, and the related effluent disposal system.

In 2006, Pima County Wastewater Management Department (PCWMD), recently renamed Pima County Regional Wastewater Reclamation Department, initiated a study of the Mount Lemmon wastewater management system, options and the watershed in which Summerhaven is located. A set of objectives for a comprehensive study were developed with input from local representatives of the United States Forest Service (USFS), Pima County Department of Environmental Quality (PDEQ) and PCWMD. The USFS had received comments from stakeholders regarding disposal of wastewater from the WWTF. The WWTF currently receives wastewater from water sources in the Upper Sabino Creek Watershed. The treated effluent is piped to outfalls (end of pipe discharge) and a spray field that are located north of Summerhaven for disposal in the Alder Creek Watershed, which is tributary to the San Pedro Watershed. The 10-acre spray field disposal area is located on federal land within the Coronado National Forest and is regulated by a USFS Special Use Permit (SUP). Treated effluent is disposed in this spray field rather than being put to beneficial use.
The goal of this study was to produce a conceptual planning document that could be implemented by Pima County, including recommendations and a budget for capital improvement. The original objectives for the 20-year planning study that were developed by PCWMD, PDEQ, and the USFS were:

- Conduct a comprehensive study of the potential wastewater service area
- Resolve the watershed imbalance related to transfer of water from the Sabino Creek Watershed to the San Pedro Watershed
- Identify legal and regulatory issues
- Identify wastewater volumes, management issues and discharge options
- Identify available financial arrangements and options

In the fall of 2006, the study project was awarded to the team of Engineering and Environmental Consultants, Inc. (EEC), Sage Landscape Architectural & Environmental, AMEC and Gordley Design Group.
The project started with a visit to Summerhaven in December of 2006 followed by a public workshop and open house held on February 10, 2007. In addition to the public workshop and open house, meetings were held with various stakeholders including the Santa Catalina Mountain Partnership, United States Forest Service, United States Fish and Wildlife Service, and the Arizona Department of Environmental Quality (ADEQ) to solicit input and comments regarding project directions. Routine status meetings were held that included various participants from PCWMD, the USFS, and Pima County Department of Environmental Quality (PDEQ).

During the public workshop/open house held in February of 2007, community participants identified six common goals that were important to them. The goals identified by workshop participants paralleled the study objectives:

- Provide wastewater capacity to meet future demand and the ability to provide service for those requesting it
- Regulatory compliance with respect to the location of discharge and spray-field
- Financial viability - identify sources and means of funding
- Environmental soundness, including enhancing vegetation, maintaining a high standard of treatment, and returning flow to Sabino Creek and its watershed
- Maximize availability of water resources by investigating uses for treated effluent, including supply of water for fire-fighting
- Public acceptability by providing consistency in plan and policy and greater service capacity
The final study was presented to the community at the Mount Lemmon Community Center on September 8, 2007 and comments were solicited and received. The following sections of this summary align with the study objectives.

**Comprehensive Study of Service Area: Background Information**

The Mount Lemmon WWTF is located at the south end of Summerhaven, a one square mile area with a high density of lots, with East and West Summerhaven located on the hills on either side of the square mile area. The WWTF began operations in 1984 and was constructed to replace an existing non-functioning wastewater treatment system and in response to concerns on the old wastewater system and septic systems in the area of Sabino Creek. Given concerns over Creek water quality, the plant was designed to discharge treated effluent through a pipeline north of Summerhaven to an outfall located in a separate watershed. Today, in a time of sustained drought and enhanced need for water conservation, transfer of water from one watershed to another watershed is of concern to stakeholders.

Sabino Creek which flows from the north to the south bisects Summerhaven into two halves. Just south of Summerhaven, Sabino Creek enters the Pusch Ridge Wilderness Area. The area contains threatened and endangered species including the Mexican Spotted Owl, bighorn sheep, Northern Goshawk, the Lesser Long-nosed Bat, Mexican Long-tongued Bat, and the Gila Chub. There are also plant species of concern within the Pusch Ridge Wilderness Area and in the Coronado Forest in the vicinity of Summerhaven. The presence of these species of concern affects development and land use options and impacts costs for regulatory compliance.

In the initial stages of this study, a sewage planning area (SPA) was defined for the wastewater treatment system. The SPA consists of the one square mile of
High density lots in Summerhaven. East and West Summerhaven were not included in the SPA because the lots in these areas are larger and can accommodate a wider range of on-site private, alternative wastewater systems compared to the smaller lots in the SPA. The lots located in East and West Summerhaven are also farther from the Creek and therefore private wastewater management systems located on these lots are less likely to impact the quality of water in the Creek than those located within the SPA. However, because the terrain is sloped towards the creek, all drainage in Summerhaven is towards the Creek. The character and setting of the SPA affects the potential size and capacity of the WWTF based on demands for the 20-year planning period.

The current WWTF is located on a small lot owned by Pima County and is rated to treat a total of 15,000 gallons per day (gpd) to secondary treatment standards, equivalent to Class B reclaimed water. The two lots located south of the WWTF are also owned by Pima County. The closest lot is vacant but is bisected by the Carter Canyon drainage, which affects development options and costs. The lot located further south currently has a school house located on it.
It was discovered that the school is inactive and both lots may be available for development as part of expansion or upgrade of the WWTF. Availability of land affects costs and options associated with improvements. The majority of land in Summerhaven is fairly steeply sloped. The amount of flat land suitable for development in Summerhaven is limited and land, in the vicinity of the current WWTF, is expensive. Bedrock also outcrops in the area or is located very close to the ground surface which affects discharge and disposal options.

The WWTF is currently served by a sewer collection main that parallels Sabino Creek and North Sabino Canyon Park Road. The collection line is sized for flow up to 500,000 gpd, and as a main collection line, the size of this line does not restrict development options for any of the scenarios identified in the study. Access to the collection main is limited due to hard rock terrain, steeply sloped land, and the absence of lateral branches of the collection/conveyance system to reach across the creek and up into the hillside. The terrain also slopes toward the Creek and the collection system parallels the creek. This means that the watershed and volume of drainage within the watershed has a direct correlation with inflow and infiltration (I&I) to the WWTF.

Prior to the Aspen Fire in 2003, the WWTF had 47 properties that were originally designated for sewer connection. These were located within a 200 foot distance from the sewer collection main. After the Aspen Fire, the United States Forest Service Special Use Permit for the spray field was amended to allow a total of 77 connections. The 30 additional connections were added to the permit as part of fire recovery efforts (Appendix E, page 14). The Pima County report Fire on the Mountain indicates that 324 structures were lost in the fire in Summerhaven (Appendix E, page 15). Records obtained from Pima County Department of Environmental Quality (PDEQ) for this study indicate that 340 lots in Summerhaven had structures damaged by fire. Whether the total number is 324
or 340, it is anticipated that previously developed lots will be redeveloped. The majority of the lots were on private conventional septic systems prior to the fire. Many land owners are waiting until wastewater management questions are answered to redevelop. Other lot owners are proceeding with development using expensive, private, on-site wastewater systems because a timeline for improvements to the WWTF has not been established or because the property owners cannot wait for improvements.

There are an estimated 679 lots located within the SPA, based on a survey of lots that was performed by TetraTech. EEC used this survey as the basis of the SPA layout for this study. It should be noted that the actual number of potential homes may be less than this due to merging of smaller lots by lot owners during the redevelopment process. Additional research of County Assessor Records may be needed as a next step to further refine lot information and allow comparison of pre and post fire trends and conditions.

Prior to the Aspen Fire in 2003, the majority of structures in the Summerhaven area were small dwellings/cabins and the total daily flow from each of these was less than 110 gallons per day. New trends in the redevelopment process are affecting the type of flow that may be received by the WWTF. Flow rates are described later in this summary. New structures are multi-story homes that may be larger than a typical Tucson household and may be designed for year round occupancy, or vacation occupancy by multiple families. This trend impacts the future of the wastewater treatment facility and any estimates of needed future capacity.

Watershed Delineation, Water Supply and Imbalance Reconciliation
Prior to addressing the study objective for watershed balancing, the Upper Sabino Creek Watershed was delineated. A watershed is an area of land on
which rain falls, and then flows as runoff toward a surface water body or infiltrates into the ground to become groundwater. The Upper Sabino Creek Watershed is a small watershed (approximately 1109 acres), which means that recharge potential from rainfall to the hydrologic system is limited.

The topography within the watershed is steeply sloped towards the inner basin and storm water runoff drains to Sabino Creek which flows south and exits the Upper Sabino Creek Watershed south of Summerhaven. The current collection system parallels the Creek, and runoff volumes and rates are relevant to planning and capacity of the conveyance system.

Drinking water in Summerhaven comes from catchment basins, local springs and two vertical wells which draw water from fractures in the bedrock. This study estimates that more than 56% of water in the watershed and groundwater comes from rainfall. The exact amount cannot be accurately assessed without further water resource investigations – which this study recommends. The dependence of the system on rainfall means that during a sustained drought there are real limits on the drinking water supply in Summerhaven and conservation efforts become vital. Impacts of a limited water supply on redevelopment must be considered when planning for a sustainable future in Summerhaven and evaluating options for wastewater management, improvements to the WWTF and discharge options. While Senate Bill 1182 waives the Arizona Department of Water Resources (ADWR) assured water supply requirement for post fire redevelopment, the actual water supply on Mount Lemmon is limited and may not be equal to the available water rights nor able to meet future demands, if conservation measures are not taken.
This study assessed the following various methods of discharge to correct the watershed imbalance or put treated effluent to beneficial use compared to the current disposal practice in the spray field:

- Recharge or injection
- Snowmaking
- Direct reuse for human consumption
- Beneficial use for fire-fighting or reforestation
- Discharge to Sabino Creek to enhance base flow

All options identified require improvements to the WWTF to achieve a higher quality of effluent to meet regulatory requirements.

Several options were dropped from further consideration and two primary options were carried forward as viable. The options that were not carried forward included recharge/injection into groundwater, snowmaking, and direct reuse for human consumption. The hydrologic setting affected the feasibility of both recharge and snowmaking. The USFS has received Tribal Nation inquiries and objections to snowmaking at Ski Valley. This input combined with the hydrologic setting resulted in dropping the snowmaking option from consideration at this time. Direct reuse for human consumption is currently prohibited by state law and is also likely to receive community opposition, resulting in this option being dropped from further consideration. If the drought continues, direct reuse may become a viable alternative necessary for not only balancing the watershed but also ensuring a future drinking water supply for the community. In order to move in this direction, Pima County may pursue a change in state law for this community. Given the unusual hydrologic setting, and unique community needs - this step must start with the support of the community.
The options that were considered feasible and were carried forward into recommendations included beneficial use of reclaimed wastewater for either reforestation or fire fighting, or discharge to Sabino Creek. Discharge to Sabino Creek to enhance creek base flow is currently prohibited by Arizona Department of Environmental Quality (ADEQ) rule in Arizona Administrative Code (AAC) R18-11-123(A). Pima County can petition ADEQ to revise this rule but the next regular opportunity to revise the rule is in 2010 (in conjunction with the departments Triennial Review). Steps to improve treated effluent quality will be needed for a successful petition in order to show that surface water quality standards will be satisfied for discharge to the creek. While this discharge option may improve base flow to the Creek it does not keep the water in the upper watershed. Sabino Creek flows out of the upper watershed south of Summerhaven. There are also potential risks associated with enhancing the base flow in a creek that provides habitat for threatened and endangered species of concern. Once this base flow is created, PCWMD may be limited in its ability to cease discharge, also the required quality of effluent must be equal to or potentially better than Arizona Surface Water Quality Standards and continuously maintained at that high quality level. This would require substantial improvements to the current WWTF. Discharge to Sabino Creek, although not without limitations, is a viable option under the right circumstances, and if developed in parallel with other options.

Treated effluent from the wastewater treatment facility could immediately be used for fire-fighting if a storage tank is constructed in Summerhaven. In the event of a structure fire or forest fire an initial supply of water would be available and would offset the current practice which consists of using potable water for fire fighting and/or hauling or flying water up the mountain for fire suppression.
Beneficial use of the treated effluent for irrigation was explored over the course of this study. Use of reclaimed effluent for reforestation is a viable alternative if a subsurface drip irrigation system is installed to deliver water to individual seedling trees. If this activity is performed in the Upper Sabino Creek Watershed, reclaimed water should be applied at consumptive use rates based on modeling data to demonstrate that applied reclaimed water is not reaching the Creek and violating the prohibition on discharge of wastewater to the Creek.

The options of beneficial use and discharge to Sabino Creek were carried forward into recommendations for this conceptual planning document as viable means for putting wastewater to beneficial use compared to the current practice which disposes of treated effluent in a different watershed than the watershed of origin.
Legal and Regulatory Issues

This study involved an overview of the historical legal issues associated with the facility and a comprehensive assessment of the current and future regulatory setting for wastewater management and improvement options. The capacity of the WWTF is currently limited not only by the rating of the plant for 15,000 gpd flow, but also permit limits for peak and average daily flow. Options for discharge are limited by ADEQ rule which prohibits discharge of wastewater to Sabino Creek and also the Pima Association of Government (PAG) 208 Certified Area-wide Water Quality Management Plan which does not allow discharge of wastewater to Sabino Creek.

The current peak flow limit in various permits which regulate the facility operations and discharge is 17,000 gpd. The average daily flow limit based on a monthly average is 12,500 gpd, and the total flow limit in the Type 1.09 General Aquifer Protection Permit is 20,000 gpd. Base flow to the WWTF (post-Aspen Fire) is approximately 2,000 gpd, which is well below the permit limits. The current base flow comes from only 19 active connections. As connections increase, base flow will increase and approach permit limits. Peak flows on holidays and weekends can reach up to 3 times the base flow to the WWTF. Peak flows are currently below permit limits but trends suggest that in the short term (3 years or less) peak flows will exceed permit limits if no action is taken.

Discharge to the spray field that is used for disposal of treated effluent is regulated by a USFS Special Use Permit. The process to amend this permit varies depending on the extent of changes. Flow limits found in the permit may be amended, but USFS representatives strongly caution that stakeholders already object to the continued practice of transferring water to a watershed that is different than the watershed of origin. A clear objective stated in the current SUP is to return the treated effluent to the watershed of origin, which is the
Upper Sabino Creek Watershed and equates to phasing out use of the spray field.

The Type 1.09 General Aquifer Protection Permit (APP) is a type of grandfathered permit by ADEQ rule. If the 20,000 gpd general permit limit is exceeded or the WWTF is modified, this permit becomes void and an individual Aquifer Protection Permit must be obtained prior to startup of operations. The APP process can take up to 18 months, which drives the timeline for improvements. If the WWTF is modified, the quality of effluent produced after modification will need to meet new facility Best Available Demonstrated Control Technology (BADCT) treatment performance standards which are essentially equivalent to A+ reclaimed water standards (with the exception of filtration for turbidity which is beyond BADCT standards but required for A+ classification for reclaimed use).

Discharge to Sabino Creek requires an Arizona Pollutant Discharge Elimination System permit (AZPDES) for an end of pipe discharge (or “outfall”) to the Creek and an individual APP. This option is not feasible until the ADEQ Surface Water Quality Standard which prohibits discharge of wastewater to the Creek and the 208 plan are revised. The next regular opportunity to revise the rule which contains this prohibition is in 2010. In order to petition for this rule change and ensure that treated effluent meets required standards for Sabino Creek in rule (Arizona Surface Water Quality Standards), the quality of effluent produced must be improved through additional treatment. Effluent must meet Surface Water Quality Standards (SWQS) and satisfy BADCT treatment performance standards for a new facility regulated under the APP program. Currently copper and zinc levels in the effluent do not meet surface water standards, and denitification and dechlorination (to reduce trihalomethanes) or alternative methods of disinfection would need to be explored to achieve effluent that meets SWQS and BADCT
standards. In order to achieve the SWQS for copper and zinc, additional
treatment must be added to the plant beyond treatment needed to achieve
BADCT.

Improvements to the plant are needed to achieve higher quality of treated
effluent in order to increase the discharge options which result in beneficial use
and result in water conservation. Improvements result in new permitting needs
and the timeline for permit acquisition is an important component in planning
and scheduling. Improvements can either be achieved through upgrading the
existing plant or through replacement of the plant. Upgrading the treatment
plant effluent quality alone is a short term solution, and will not increase plant
capacity, but will improve the quality of treated effluent or reclaimed water
produced to a level that is needed to enhance discharge options and return the
wastewater to the Upper Sabino Creek Watershed. Any plant upgrade and/or
replacement will require acquisition of new permits.

<table>
<thead>
<tr>
<th>Permit / Program</th>
<th>Expiration Date</th>
<th>Flow Limits</th>
<th>Renewal/ Replacement Time</th>
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<tbody>
<tr>
<td>APP General Permit</td>
<td>When rule is no longer satisfied</td>
<td>20,000 gpd</td>
<td>~18 months</td>
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<td>Type 1.09</td>
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<td></td>
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<tr>
<td>AZPDES</td>
<td>~Dec 2011</td>
<td>12,500 gpd mo.Ave, 17,000 gpd</td>
<td>~ 18 months</td>
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<tr>
<td></td>
<td></td>
<td>Daily Peak</td>
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<tr>
<td>USFS Special Use</td>
<td>June 1, 2022</td>
<td>12,500 gpd mo.Ave, 17,000 gpd Daily</td>
<td>NEPA - up to 2 yrs</td>
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<td></td>
<td></td>
<td>Peak</td>
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<tr>
<td>PAG 208 Plan</td>
<td>NA</td>
<td>18,189 gpd (1981) and no discharge to Sabino Creek</td>
<td>~9-18 months</td>
</tr>
</tbody>
</table>
Reclaimed use of the treated effluent for reforestation would require improvement of effluent quality and also that an individual APP and reclaimed permit(s) be obtained. Modeling with the Blainey Criddle Model will be required to demonstrate that any reclaimed water applied to the reforestation area will be at or below the consumptive use rates required by the Arizona Department of Environmental Quality, to demonstrate that irrigation rates are consistent with tree uptake.

If options for discharge such as effluent holding and fire suppression or reforestation are pursued and private land is not available, then any use of the Coronado National Forest will result in the application of the National Environmental Policy Act (NEPA) requirements. The level of effort for NEPA varies depending on the potential impact on the land use. Discharge to Sabino Creek will likely result in the highest level of NEPA requirements, while construction of a storage tank on already developed land will likely result in the lowest level of NEPA. Requirements for reforestation will depend on where the target area is located, whether it is near the Pusch Ridge Wilderness Area boundary, which watershed the site is located in, and steps needed to construct the irrigated acreage and whether the area has been cleared and contains species of concern.

Beneficial uses and return of the wastewater to the watershed of origin are supported by the community and stakeholders, but necessitate improvements to or replacements of the WWTF to achieve a higher effluent quality. A flow chart was developed which depicts the regulatory steps for new options compared to continued use of the spray field. Parallel development paths are recommended in case one of the options is not successful. For example, in case the ADEQ rule revision process is not successful, pursuit of alternative options is recommended.
by this study. The chart developed for this study depicts regulatory steps for compliance with various program requirements.

This study compares replacement or upgrade of the WWTF and providing a larger treatment and conveyance system with capacity to serve the entire community and SPA in support of redevelopment. A large portion of structures in Summerhaven were lost to the fire and were previously on private septic systems. Given the high density of lots in the SPA, reliance on septic systems may have the potential to adversely affect human health and the environment by affecting the quality of water in Sabino Creek. The terrain of Summerhaven limits the types of private systems that can be installed and results in higher-cost, private, alternative systems. Currently Pima County DEQ is recertifying conventional septic systems that were permitted prior to the Aspen Fire - if the system is still functional, was not damaged in the fire, and the same size house is built on the lot. If this practice continues and private on-site systems are re-installed, then after redevelopment the SPA will again once contain a high density of on-site septic and wastewater systems. Stakeholders agree that serving the area with a WWTF that treats wastewater to achieve improved water quality will be better for the environment and supportive of conservation measures compared to on-going reliance on a high density of individual septic systems.

This study evaluates Pima County septic system certification and permitting practices and recommends development of a comprehensive wastewater management strategy as part of redevelopment of Summerhaven that serves as the basis of decision making for improvements to the WWTF, increased WWTF capacity, and development of new discharge options. Ultimately, an expanded conveyance system is needed in this community to switch the focus to treatment at a WWTF rather than reliance on individual on-site systems.
Given the past high density of on-site septic systems, new systems that are being installed on small lots over sloping bedrock with little soil cover, and the large number of unclosed systems that remain in place on lots that lost structures during the Aspen Fire, this study also recommends assessing Sabino Creek for septic system impact. A routine sampling program is needed to evaluate whether the Creek is impacted by past and present practices and to assess effects of rainfall events and flood events on Creek water quality, flow, and potential subsurface contaminant migration.

**Wastewater Volume, Discharge & Management Issues**

A number of factors must be considered to evaluate wastewater options during the 20-year planning period, as well as the short and long term capacity and treatment needs of the community. The factors that directly impact wastewater volume that may be received by this WWTF include: number of lots that may connect without an expanded conveyance system in place; the number of lots that may connect with an expanded conveyance system in place; the range of flow per lot for redeveloped homes compared to pre-Aspen Fire flow rates; and, proposed condominium complexes and the timing of construction of the condominiums.

As Summerhaven undergoes redevelopment, lots that had homes or businesses on them prior to the fire are likely to be redeveloped. The majority of these lots had on-site private wastewater systems such as septic tanks before the Aspen Fire. Prior to the fire approximately 212 lots in the SPA were on conventional septic systems. A portion of these have been re-certified by PDEQ after the Aspen Fire.
While a total of 76 systems have been re-certified in Summerhaven since 1987, of this number PDEQ has only re-certified approximately 35 systems within the SPA since the Aspen Fire. Records provided by PDEQ and Pima County Development Services (DS) indicate that up to 66 applications for general permits for on-site wastewater systems have been received for lots in Summerhaven. Of these 52 lots are within the SPA, and 33 of these lots had fire damage. When tallying pre and post-fire development numbers for assessing connection potential and reviewing application numbers, a portion of the total number of applications received by PDEQ were received prior to the Aspen Fire and had structures lost in the fire versus lots requesting new systems since the fire.

Performing additional records research to assess permitted systems and correlate findings to addresses and lot owners will facilitate communication with lot owners and aid in further assessing capacity needs. This information is vital for assessing connection potential to determine the total number of lots that are truly available for connection in the SPA (if an expanded conveyance system were in place to serve the SPA) versus those that have already obtained permits for re-certified septic systems on private on-site systems. Adequate and accurate assessment of the potential demand for wastewater treatment service in the SPA and the possible need for increased capacity of the WWTF, and assessment of revenue potential all rely on acquiring this additional information as part of plan implementation.

The current system is rated to treat 15,000 gpd and has permit limits of average daily flow (ADF) 12,500 gpd, peak flow (PF) 17,000 gpd, and total daily flow of 20,000 gpd. While the base flow today is 2000 gpd, if more lots are connected and 324 to 340 lots were previously developed in Summerhaven and may be
redeveloped, additional treatment capacity must be included in improvements to the WWTF.

Actual future capacity of the WWTF cannot be accurately determined without additional, specific information regarding current building permits in process, discharge authorizations issued by PDEQ, actual flow rates that can be expected per lot with new home trends, and a commitment by PCWMD to install an expanded conveyance system in the SPA.

Flow Projections - Central to planning efforts and evaluating options for the WWTF are short and long term flow rates including peak flow and average daily flow. The planning period for this study is 20 years. However at the time this study was performed, less than 4 years of post-fire flow data was available to use as the basis of decision making. The average daily flows observed to date and for the 19 active connections (including commercial users) is in the 110 to 150 gpd range (150 gpd was used in the projection graph) per connection. Data in PDEQ files suggests that new homes under construction in Summerhaven are larger than old homes. None of these larger homes have connected to the WWTF to date, and instead the trend is towards continued reliance on private on-site wastewater systems. If these larger homes are connected to the system, higher daily flow rates are likely when compared to pre-fire cabins. The flows for these new cabin homes may exceed flows from a typical Tucson household – perhaps greater than 230 gpd. Information regarding design flow for Type 4 on-site systems permitted by PDEQ suggests that the average daily design flow of new homes in Summerhaven could range from 300 to 750 gpd. Since the data pool is limited and these larger homes are not yet connected to the system, the actual flow is not metered and is unknown. Additional water consumption data and wastewater metering data are needed to assess actual flows that may result
from the newer structures.

**Possible Flow Projection Range & Permit Limits: Peak Flow**

According to PDEQ data, a total of 12 lots that lost structures to the Aspen fire are still undeveloped and are located within 200 feet of the current sewer collection main. Owners of these lots could request to connect to the WWTF immediately or connection requests could follow the trend since 2003 of approximately 3 requests for connection per year. Given the short distance to the collection main, connection for these 12 lots is feasible today. Since the current data suggests a trend of three connections per year, EEC used this as a basis of flow projections. Projections were made based on flow rates of 150 gpd for each of these connections, 230 gpd (similar to a typical Tucson household) and 300 gpd (based on design information for on-site applications received by PDEQ for new homes). The report relies on 150 gpd as the basis of projection for short and long term needs, but the higher flow rates must also be acknowledged as possible, given new trends. Therefore, information presented in one of the progress meetings and at the public meeting on September 8, 2007
included augmented flow projection information and graphical representation to illustrate possible scenarios and how these related to the need to change the WWTF to solve short and long term demands. PCWMD is faced with the need to plan for this community and wastewater treatment demands, and planning must include consideration of the range of possibilities, including varying flow scenarios that could occur during redevelopment.

All the options graphically displayed by EEC in presentations illustrate that a short term need exists to manage and respond to expected peak flows to the WWTF. The projected timing of peak flows exceeding permit limits is in the 2009 to 2012 year range. The timing of this short term need is in part driven by construction of two new condominium complexes and also by the rate of flow that may result from larger homes.

Two condominium complexes (The Village Center and The Orchards) are planned for Summerhaven and the connection of these two complexes to the system results in a short term issue associated with peak flows. Adding flow from the complexes to the base flow and peak flow of the current WWTF results in short term exceeded permit limits. Peak flows can be addressed through on or off-site flow equalization (EQ) measures. Flow equalization can be added to the WWTF as a part of upgrades or plant replacement, or private flow equalization can be added at the condominium complexes to help moderate existing peak flows. A new 100,000 gallon storage tank that holds treated effluent for fire fighting can also help moderate flows to ensure that USFS SUP average daily flow limits are not exceeded by the WWTF.

Available Land and Replacement Versus Upgrade - A school located on the lot immediately south of the existing WWTF is owned by Pima County and is currently inactive. This property can eventually be used for expanding the
A short term WWTF upgrade can be constructed on the existing site to handle denitrifying the wastewater and peak flow equalization. Later, when an expanded collection system is in place and flows increase, the upgraded WWTF can be replaced and operated side by side with a new plant during transition from one plant to the other utilizing the adjacent property.

This study evaluated a range of options from doing nothing, to upgrading or replacing the plant at the current location to replacement of the plant at a new location. Given the limits on available, flat land and the cost of land, replacement of the WWTF at a new location was not carried forward into the final recommendations.

Stakeholder input regarding beneficial use of wastewater and returning the wastewater to the Upper Sabino Creek Watershed of origin eliminated the “do nothing” option. These options require that the WWTF attain a higher quality of treated effluent either through upgrade or replacement. Peak flow projections also mean improvements are needed in the short term to equalize flow. Further, flow projections indicate that expansion will be needed within the 20-year planning period, the timing of the expansion and size/capacity are based on factors that are not yet fully understood or quantified and need further study.

**Timing of Improvements** - Information shared regarding potential availability of additional land in the immediate vicinity of the current WWTF changes options such as upgrading the plant or replacing the plant in response to demand. Timing is also affected by timelines associated with permit acquisition, regulatory compliance, and design and construction. Therefore, planning is needed and the sooner a unified wastewater management strategy is formed the better - since firm projections cannot be made without this strategy in place and also a
decision made regarding whether or not to install a conveyance system as part of the improvements.

Upgrade of the WWTF - Conceptually, upgrading the WWTF consists of achieving improved reclaimed water quality, meeting Surface Water Quality Standards for potential discharge to Sabino Creek, and meeting new facility BADCT treatment performance standards for regulatory compliance. Upgrades as defined by this study do not include increasing the WWTF treatment capacity, and conceptual costs assume that either on-site flow equalization at the effluent pump station or private flow equalization is used to manage peak flows for short term peak flow demands. Costs for conceptual upgrades were based on the plant remaining at the current WWTF location and no increase in plant treatment capacity. Therefore, this is perceived to be a short-term stop-gap solution only.

Replacement of the WWTF and Expansion - Trend and projection data indicate that expansion will be needed within the 20-year planning period, however the exact timing within the 20 year period and the actual treatment capacity that will be needed are still uncertain. The need for expanded capacity could occur as early as 2011 or as late as 2022. The uncertainty is due to the absence of a conveyance system that provides service throughout the SPA. Without a conveyance system that provides coverage within the SPA, private lot owners are not likely to request connection or bear the cost. Uncertainty is also related to actual versus theoretical flow for multi-story homes that are under development in Summerhaven and whether the SPA community will continue to move towards private on-site systems rather than support development and improvement of the WWTF. Several community members present at the public meeting held on September 8, 2007 indicated that they are waiting to proceed with redevelopment to see whether a conveyance system will reach the vicinity of their lots. Others indicated that their needs for redevelopment were more
immediate and they could not wait four to five years for a solution to obstacles for connecting to the WWTF for service.

This study evaluated the following options for replacement of the WWTF using a matrix assessment: Sequencing Batch Reactor (SBR) with filter; Membrane Bioreactor (MBR), and use of the Marana Extended Aeration package plant (EA). The options were evaluated using 10 weighted criteria which were developed with PCWMD. Based on the evaluation, the treatment technology with the highest or best overall score was SBR. Costs for replacement of the WWTF were developed assuming a 50,000 gpd SBR plant is selected and constructed, which is the recommended treatment method based on this study and the matrix evaluation process. The size of the plant used for cost estimating is conceptual only and was selected for Capital Improvement Planning (CIP) purposes. The actual capacity of a replacement plant cannot be determined until several major decisions are made by Pima County (installation of an expanded conveyance system, etc.) and additional data regarding flow, on-site systems and current building permits and land development are in-hand. Additional research is needed to form the basis of capacity estimates and planning. With additional data, and a schedule for installation of an expanded conveyance system in the SPA (if one will be installed), the timeline for replacement and expansion can be developed and cost estimates further refined.

Conceptual Conveyance System - The terrain and status of roads in the area must be included in discussions regarding installation of an expanded conveyance system. Therefore, the conceptual conveyance system developed for cost estimation should be considered preliminary. Many of the roads in the area are un-improved and do not follow the lot configurations shown in the SPA lot layout diagram. This means that conveyance system costs may run towards the high end of estimates and the conceptual design used as the basis for cost
estimation only reaches portions of the SPA. Further, to connect a portion of the lots in the SPA to the conveyance will require crossing private lots with lateral conveyance lines, which presents challenges.

**Conceptual Conveyance System- $3.2-$4.7M**

Although preliminary costs were developed for the conceptual conveyance system as part of this study, a timeline for construction of a conveyance system was not included in this study. Realistically if started immediately, installation of a conveyance system in the Summerhaven terrain could take up to five years from design to operation.

**Costs, Financial Arrangements and Options**

This study provided a series of options for improvements at Mount Lemmon and recommendations were made to PCWMD. However the ultimate selection of options for improvements including new discharge options rests in the hands of Pima County and the community. Given the remote location and terrain, costs
for improvements which serve a small community are high compared to costs for systems located in the metropolitan area which serve larger populations. The setting in Summerhaven is unique compared to new subdivisions within the metropolitan Tucson area.

Without change and improvement to the current system, wastewater will continue to be transferred to a different watershed than the watershed of origin and there are risks and liabilities associated with this course of action. The current approach, which relies on disposal of wastewater rather than beneficial use, is not sound conservation. Given suspected limits to the water supply, which relies on rainfall, continuation of the current disposal practice may potentially be contrary to a sustainable future for the community of Summerhaven. Continued drought coupled with the absence of both of the following:

- conservation measures in a pristine mountain environment
- unified strategies and public policies which protect the quality of Sabino Creek

may adversely impact the future of Summerhaven. All stakeholders involved agree that improvements to the WWTF and installation of an expanded conveyance system to move away from reliance on individual on-site private wastewater septic systems provides improved protection of the environment, including Sabino Creek and is preferred. It is the cost of the system that is the issue. The value of protecting a unique environment which supports threatened and endangered species and includes a rainfall based drinking water system which is limited in supply, are difficult to assign dollar values when compared to the small population that is served by the improvements. Funding of improvements is therefore very important, given the limited population served and the unique environment of Summerhaven.
Funding Options – A balance of approximately $6.85 million remains from the original bond amount. The bond was used to fund this study and road improvements made in the area. This study identified a wide range of potential funding sources including sources of grant money. However, some options identified are more feasible than others. Three potential funding sources that require further study include: Seeking federal funding through Representative Raul Grijalva, Chair of the National Parks, Forests and Public Lands Subcommittee towards the water storage tank for fire suppression and reforestation projects which may utilize Coronado Forest lands; University of Arizona Technology and Research Innovation Fund (TRIF) and the Arizona Water Institute (AWI); which is an alliance between the three universities in Arizona and includes sponsorship from agencies such as the Arizona Department of Environmental Quality (ADEQ). The latter funding source may support water studies that will be needed for regulatory compliance and water resource investigations.

Conceptual Cost Projections – Conceptual costs were developed as part of this study for use in Capital Improvement planning. The costs presented in the report are ranges from -30 to +50% and are based on assumptions, and 2007 dollar value. Actual costs may vary based on the design and implementation process and choices made by PCWMD and Pima County. Costs presented in Figure 9-2 in the report were adjusted with costs in Section 5 tables to develop totals that include estimated regulatory and design costs, as indicated below.
### Summary of Conceptual Costs

#### Upgrade of the WWTF and Multiple Discharge Options

<table>
<thead>
<tr>
<th>Item</th>
<th>Low Cost (millions or M)</th>
<th>High Cost (millions or M)</th>
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<tr>
<td>Upgrade the WWTF</td>
<td>$0.9M</td>
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<td>100,000 g Storage Tank</td>
<td>$0.2M</td>
<td>$0.3M</td>
</tr>
<tr>
<td>Reforestation</td>
<td>$0.5M</td>
<td>$0.8M</td>
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<tr>
<td>Outfall to Sabino Creek</td>
<td>$0.8M</td>
<td>$1.7M</td>
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<tr>
<td>Conveyance System</td>
<td>$3.2M</td>
<td>$4.7M</td>
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<td><strong>Total</strong></td>
<td><strong>$5.6M</strong></td>
<td><strong>$9.3M</strong></td>
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#### Replacement of the WWTF and Multiple Discharge Options

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<tr>
<td>Outfall to Sabino Creek</td>
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<td>$1.7M</td>
</tr>
<tr>
<td>Conveyance</td>
<td>$3.2M</td>
<td>$4.7M</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>$7.2M</strong></td>
<td><strong>$12.7M</strong></td>
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This study recommends pursuing parallel path development of disposal options and the processes, including regulatory steps for compliance, are depicted in the figure at the end of the Executive Summary. The estimated conceptual cost of improvements to the wastewater system in Summerhaven is high, given that the population served by the system is small. The cost of improvements to the Mount Lemmon WWTF and conveyance system are affected by the terrain, and the remote location.
Closing

Summerhaven is situated in a unique environment and the drinking water supply in the area is limited and potentially vulnerable, especially during a sustained drought. Stakeholders have expressed that protection of the environment, ensuring an adequate water supply, balancing the watershed, and providing wastewater service to meet community demand are important objectives. The potential cost to be borne by community members is also an expressed concern.

Additional steps are important for Mount Lemmon to ensure protection of the quality of water in Sabino Creek, balance the watershed, ensure a sustainable future, and in general respond to objectives of this study and community stakeholders. A unified wastewater management strategy is needed to protect the environment and public health, and respond to stakeholder concerns. Key decisions must be made by Pima County before implementing this plan, which is conceptual, including whether to form an Improvement District, whether to install and front the costs to expand the conveyance system and the timing of construction, and strategies for management of on-site private wastewater systems.

Options presented in the report and recommendations made by the team are based on assumptions and information provided by Pima County. Additional investigation is needed as part of implementation of this plan before making decisions such as whether to perform a short term upgrade and then expand the WWTF capacity after a conveyance system is installed or to expand the WWTF capacity in the short term. This report recommends replacement of the WWTF in the short term. This recommendation is conservative given that up to 12 lot owners could request to connect to the WWTF immediately and new structures may have significantly higher daily and peak flow rates than pre-fire cabins, and it assumes that providing service to the community is of value to PCWMD and
compliance with regulatory programs and permit limits is also of value. Many of the permits required for expansion, upgrade, and new disposal options affect development timelines and require advance planning and scheduling. Replacement of the WWTF will result in improved effluent quality suitable to support all reclaimed and beneficial uses identified in this study that will support water conservation.

Community support is an integral part of plan implementation and decision making. Communication with the community and stakeholders regarding next steps and keeping the stakeholders involved are vital steps to successful implementation of this plan and making improvements to the wastewater management system at Mount Lemmon that supports redevelopment of Summerhaven in follow-up to the Aspen Fire.
Parallel Path Development for Plan Implementation

**WWTF Upgrade and Beneficial Use Options**
- Design & Develop Reclaimed Strategies 2008
- 208 Plan Consistency Review 2009
- Obtain Individual APP A to A+/BADCT Amend USFS SUP (as-needed) 2011
- Construct Upgraded WWTF
- Obtain Reclaimed Permits

**San Pedro WS Site Specific Standards Cu & Zn**
- Perform Study for Site Specific Standards
- Petition for Rule Change 2010 Triennial Review
- Amend AZPDES Permit - Sprayfield

**Sabino Creek Discharge Option**
- 208 Plan Amendment 2008 – 2010
- Collect Creek Data (as-needed) Perform NEPA & SWQS Studies
- (Option) Advanced Treatment for Cu and Zn Removal
- Petition for Rule Change – Lift Sabino Creek Prohibition & Set Standards 2010 – 2013
- Select Outfall Location
- Apply for Individual APP and AZPDES Amendment 2019

**WWTF Expansion (2017)**
- 208 Plan Amendment 2017

**Increased Beneficial Use Options**
- Firefighting
- Reclaimed Reforestation
- Consumptive Use (application only)

**Private Site Available?**
- YES
  - Form Agreements for Use of Private Land
  - Project Scoping & Site Selection
  - Assess for Categorical Exclusion (CE)
  - If No CE, Initiate NEPA
  - Develop Tank Site & Pipeline (Design & Construct)

- NO
  - Off-site Storage Tank
  - Develop Site Selection Criteria & Conceptual Design
  - Identify Suitable Sites (USFS & Private)
  - Screen Sites with Baseline Studies

**Continued Use of Sprayfield Option**
- (until 2022)

**Alternative Disposal Location Options**
- Outfalls to Sabino Creek
- Application as Disposal
- Snowmaking Options
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# DEFINITIONS

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<tr>
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1.0 Background

1.1 Project Overview

Pima County Wastewater Management Department (PCWMD) manages a small, outlying wastewater conveyance and treatment system in the unincorporated community of Summerhaven, situated near the summit of Mt. Lemmon in the Santa Catalina Mountains outside of Tucson, Arizona. The existing system consists of approximately 3,700 feet of gravity sewer lines, 19 manholes, an influent pump station, a wastewater treatment facility (WWTF) and approximately 5,000 feet of effluent pressure line to disposal spray fields. The WWTF consists of, a circular oxidation tank aeration basin or “ditch” with chlorination and dechlorination providing secondary treatment. Sludge from the WWTF is currently stored on site in a tank, aerated and then trucked off-site for disposal in a PCWMD man-hole. Approximately one 1800-gallon truckload of sludge is hauled from the Mount Lemmon WWTF per week for an estimated total of 48 per year (Gall, 2007).

The WWTF is located within the Sabino Creek (Rillito River and Santa Cruz River) watershed, while disposal spray fields are located in the San Pedro River watershed north of Summerhaven. The WWTF is situated at Lots 2 and 3, Block 40, of the Summerhaven Subdivision, and it was constructed as a new package facility in 1982 at a permitted capacity not exceeding a monthly average of 12,500 gallons per day (GPD) and a single-day maximum of 17,000 GPD.

Effluent disposal facilities are located on approximately 10 acres of the Coronado National Forest and consist of an effluent storage tank, a booster pumping station, requisite power and controls, 6 effluent spray fields with 13 spray heads in each field, 3 surface discharge points, a fence line enclosing the facilities, and an access road. This system operates with the permission of the U. S. Forest Service (USFS) under Special Use Permit SAN0139, February 18, 2003, and amended December 1, 2004.
In recent years there have been two major wild fires in the Summerhaven area: the Bullock Fire in 2002 and the Aspen Fire in 2003. The Bullock fire consumed 31,000 acres while the Aspen fire burned 85,000 acres. Major structural damage occurred throughout the Mt. Lemmon community during the Aspen Fire, particularly to the inhabited and commercial areas of Summerhaven.

Flow and influent loadings increased at the WWTF to their highest levels in January 2005, 10,200 GPD. This high flow rate was attributed to major infiltration problems related to the Aspen Fire which have since been remedied. Flow and flow projections for future development are discussed in detail in Section 8.7 of this report.

The facility is required to meet secondary treatment limits, and it is currently operating under Arizona Pollution Discharge Elimination System (AZPDES) variances from ADEQ for copper and zinc, based on high levels of those contaminants in the local source water. The AZPDES permit and variances are discussed further in Section 3.3 of this report. For the most recent average peak season (June-July 2006), WWFT influent flow was approximately 2,600 GPD, and the most recent average daily effluent flows were 1,508 and 1,847 for November and December 2006.

As rebuilding and new development occurs, there is general concern about when the increasing influent flows may approach a level that will exceed the system’s treatment and disposal capacity and regulatory permit limits. Therefore, it is critical to conduct a study that will investigate the following:

- current and foreseen customer bases, conveyance systems, treatment facilities, and disposal methods
- present and projected system and community circumstances
- projected system and community strategies/efforts
- applicable industry technologies that will apply to upgrade and expansion
This study will develop a comprehensive overall strategy (demand, technology, locations, phasing, and cost) for developing the appropriate wastewater system service area and infrastructure for the Mt. Lemmon community.

PCWMD selected the team of Engineering and Environmental Consultants, Inc. (EEC), AMEC, Sage Landscape & Environmental (SAGE), and the Gordley Design Group to develop the comprehensive Mt. Lemmon Service Area Watershed Study and Wastewater Management Plan in order to explore options for wastewater management in the Mt. Lemmon area. The inspiration for this project was a combination of the following: expected accelerated rebuilding and redevelopment in the Summerhaven residential and commercial development, limits placed on discharge in various permits, an aging wastewater treatment facility, and an awareness of the unique environmental conditions in the Mt. Lemmon area.

This final deliverable is a Comprehensive Service Area Watershed Study and Wastewater Management Plan identifying conditions and circumstances existing in and around the Mt. Lemmon community from a variety of related standpoints, and the significant issues and challenges involved in planning wastewater systems for the reasonably foreseeable future (20 years). This report includes the sequence and nature of all capital projects at the Mt. Lemmon Wastewater Collection, Treatment, and Disposal Facility necessary to address the rehabilitation, expansion, relocation, and/or modification of the facilities, in light of anticipated community rebuilding and growth requirements.

1.2 Mt. Lemmon Wastewater History
The Summerhaven Area originated as a timber claim under the Timber Homestead Act of 1882. After the timber was cut, the claim was abandoned. In the 1920s the timber claim was subdivided into 700 lots. The Mt. Lemmon Highway construction in the 1950s lead to home construction with private on-site
sewage disposal systems. Many of these systems subsequently were shown to be failing through the use of dye tracer tests.

In 1958, an improvement district was formed, and a sewerage system consisting of an 8-inch sewer, 5,000 gallon septic tank, chlorinator and sand filter were installed. This system was plagued with problems: the filter field was clogged by flooding and failed shortly after construction; illegal and lateral connections with improper joint construction permitted infiltration, causing hydraulic overloading of the system. Ultimately, the facilities could not meet the subsequent NPDES discharge requirements.

To find a solution to these long lasting problems, Pima County hired Finical & Dobroski and Brown & Caldwell in 1975 to prepare a facility plan and an environmental impact assessment (EIS) for a replacement system. Ultimately, construction of a new 25,000 GPD biological treatment facility discharging to Sabino Creek was recommended in order to serve Summerhaven. Construction of this proposed system was expected to cost $341,000 and the original concept was for the facility to be capable of expansion to 150,000 GPD.

In March 1977 the County requested an addendum to the Facility Plan from LGC Engineering Associates, Inc. LGC recommended a 15,000 GPD extended aeration facility with discharge to Sabino Creek with a construction cost estimate of $159,000.

Finical & Dobrowski (1977) provided a comprehensive history of water and wastewater development within the project area as part of a former EIS prepared for Pima County. Some of their key observations relevant to the effect of wastewater treatment on watershed hydrology in the current project area include:

• Until the 1950s, sewage disposal was by private systems, either pit privies, septic tanks or vault toilets. However, in the mid-1950s dye tracer tests demonstrated that the septic tank-leaching systems were little better than direct pipelines through the fractured and decomposed granites from the source of the pollution to the creek.
In 1958, Pima County formed an improvement district and constructed a treatment facility. The system was plagued with problems since its conception. The filter field was located in a flood prone area and became clogged and ineffective. A bypass directed effluent from the septic tank directly to Sabino Creek.

The Upper Sabino Creek watershed encompasses three areas of heavy and localized human activity: the Mount Lemmon Ski Valley, the patented land of Summerhaven, and the leased and unleased Forest Service property of which the Marshall Gulch picnic ground is part.

The study area is characterized by extremely rugged terrain. Winter access to many of the lots in Summerhaven is by 4-wheel drive vehicles only. Approximately 18% of the 200 acre community of Summerhaven is unsuitable for development because of the high cost of construction on slopes in excess of 50%. The majority of the study area contains shallow soils and large granite outcrops. The topographic, geologic, and soil constraints of the study area eliminate the possibility of leaching field and septic tank systems as viable alternatives for wastewater treatment. Because of the recreational nature of the study area, wastewater flows generated within it, experience extreme flow variations. This coupled with annual snowfall of over 90 inches and extreme temperature variations, further constrain process selection.

As an alternative to stream disposal of the treated effluent, land application was investigated. The Forest Service has indicated a willingness to cooperate and provide land south of the treatment plant, on slopes above the Marshall Gulch picnic area. Because of the soil properties of the area, its limited water holding capabilities, and its susceptibility to seasonal freezing and to erosion during non-freezing seasons, land application presents a poor alternative for effluent disposal and is therefore discounted.

There exists a possible utilization of wastewater for fire suppression in Summerhaven and snowmaking at Ski Valley. A three acre receiving pond would be required to store wastewater for snowmaking...During the summer months the overflow wastewater could be used for irrigation of county grass in the area of the treatment plant facility. The expense of a piping system, pumping, tanks, O & M, and the unavailability of adequate acreage for development of a holding pond make this approach unfeasible at this time.

The Mount Lemmon Task Force (1981) reviewed previous reports and studies, and developed a detailed chronology of the wastewater treatment and disposal issues in the project area. It included recommendations from a previous report which strongly recommended against the proposal to install soil absorption systems for parcels within Summerhaven. This report acknowledged the...
"shattering of the previous held generally accepted belief that soil absorption could work for Mount Lemmon wastewater disposal."

Hennington (1981) reported the following key findings related to the proposed wastewater treatment system at Summerhaven, based on review of previous studies:

- Scientific testing has found that stream pollution levels increase when Sabino Creek passes through Summerhaven.

- Treated wastewater introduced into the stream at the southern boundary of Summerhaven sharply increases the water quality of Sabino Creek. Even though the water quality of Sabino Creek is poor when leaving Summerhaven, vigorous stream action is capable of naturally purifying the contaminated water.

- From all analysis and information gathered on water studies of the Sabino Canyon watershed, it is highly unlikely that the mountain village at the tip of the watershed has contributed significantly to the bacterial loadings in the Sabino Canyon Recreation Area.

- In all studies completed up to this date, there has been no absolute evidence which shows that pollution in the Sabino Canyon Recreation Area is caused by Summerhaven Village. There are other factors involved in the ecology of a 35 square mile watershed.

- The site picked for the spray field as most desirable for the release of treated wastewater into the San Pedro watershed is located on the eastern side of Oracle Ridge Road, which passes the old Mt. Lemmon Sawmill. This forested site is approximately 3 acres in size and has a slope of 22 degrees, or 40%. The site is located on US Forest Service land and cannot be used without the permission of the Forest Service.

- The proposed action is spray irrigation from effluent sprayers or direct discharge from perforated pipes onto the San Pedro watershed. Treated wastewater will come from a secondary plant located on Lot 40 in Summerhaven. Along the top of slopes, 7-8 sprayer groups will be alternated in order to allow the soil to recover to a non saturated condition. Further water flows will be between 10,000-20,000 gallons per day with 7,000 gallons per acre per day being the average rate of disposal. Tree roots cannot remain waterlogged for prolonged periods of time.
• Trenches were excavated in the proposed area to determine permeability and water holding capacity, but groundwater was not evident in any of the trenches.

• From the ecological Statement Report on this design idea, the San Pedro watershed would not have any adverse affects from the additional increase in water flows, but it is not known if Sabino Creek may be degraded by the decrease in water flow patterns.

• Requirements for septic tank disposal fields are such that 8 feet of soil mantle above bedrock is a minimum for successful operation. Most lots have an average of 18 inches of soil mantle over bedrock. This thin soil mantle is not adequate enough for purification of wastewater that percolates vertically through the soil. When wastewater hits bedrock, it travels horizontally through the fissured and unconsolidated bedrock almost directly into the creek bed.

• The two major sources of water are from the Upper Sabino Catchment and Pigeon Spring. Upper Sabino Catchment utilizes a concrete catchment box which collects spring water and ground water. A considerable amount of water is lost from the catchment because of inadequate size and construction.

• Because water collection or the community is dependent upon yearly rain and snowfall…the best way to alleviate this problem is to expand and rebuild the Upper Sabino Catchment, along with the construction of additional water tanks.

It should be noted that additional data is available since the above report was prepared and was reviewed as part of this study. This data is discussed in Section 2.2, where potential impact of septic systems is evaluated.

PAG updated the wastewater treatment situation on Mount Lemmon in their Areawide Water Quality Management Plan (208 Plan) (PAG 2006). PAG provided the following summary of the facility at that time:

• Sabino Creek, a popular recreation area with headwaters on Mount Lemmon, was polluted in the 1970s. Marshall Gulch picnic ground (located south of the current WWTF) was closed in 1975 because of the pollution, the major source of which was attributed to the discharge of inadequately treated sewage.

• Pima County and the Arizona Department of Health Services agreed on a Stipulation of Facts and Consent Order related to the water quality situation in July 1980. The Consent Order required construction of a new wastewater treatment facility. In April 1981, the State issued a prohibition against the
surface discharge of treated wastewater into Sabino Creek, thus forcing the County to find a different disposal site for treated effluent.

• In September 1981 the PAG Regional Council approved a 208 Plan Amendment that recommended construction of a new wastewater treatment plant that would discharge on National Forest land in the San Pedro River watershed, and limiting sewerage service to only the 47 properties the County was obligated to serve at that time. The USFS has since approved an additional 30 connections, provided the daily average flows do not exceed 12,500 GPD average flow and 17,000 GPD daily maximum flow. The revised USFS permit allows PCWMD complete discretion on which 77 properties may be served.

• The service area is primarily residential, with a few commercial customers such as restaurants and gift shops. The service area was severely impacted by the 2003 Aspen fire, with most of the buildings in Summerhaven destroyed. The WWTF itself was spared.

• Effluent disposal consists of spray irrigation on 10 acres of vacant USFS land on the San Pedro River watershed side of Mount Lemmon. The disposal area burned in the 2002 Bullock Fire, causing some damage to the disposal system. The damage has since been repaired.

• Average daily flow in FY2003-04 was 0.00162 MGD [million gallons per day]. Flows are currently minimal as a result of the 2003 Aspen fire that destroyed most of the residential area served by the facility.

In the late 1970s and the early 1980s Pima County conducted negotiations with Arizona Department of Health Services (ADHS), the precursor to the ADEQ. ADHS and PCWMD were eager to eliminate problems with the existing system however they had difficulty establishing a treatment scenario that was both cost efficient and effective at protecting Sabino Creek. In July 1980 the negotiations resulted in the Stipulation of Facts and Consent Order, No. W8008. The consent order stipulated 12 steps that PCWMD was required to take including:

• No new connections to the existing collection system
• Post warning signs about not drinking water from Sabino Creek
• Monitor water quality in Sabino Creek
• Remove the existing sand filter system and pump the existing PCWMD septic tanks
EPA subsequently denied a PCWMD application for a NPDES permit for discharge into Sabino Creek. Shortly thereafter the District Ranger, Catalina District, U.S. Forest Service, (USFS) indicated a willingness to permit exploration of the possibility of land treatment of wastewater on USFS land north of Summerhaven.

Pima County subsequently hired Camp Dresser & McKee (CDM) to prepare design drawings for a new Lakeside oxidation ditch clarifier and chlorination system with the effluent being discharged on USFS property north of Summerhaven. Construction on this spray field system was completed May 5, 1984. This treatment and disposal system has remained virtually unchanged since construction.

1.3 Collection System Overview

The existing collection system was constructed between June 1982 and May 1984, replacing the system constructed in the 1950s. According to the as-built drawings, it originally consisted of approximately 2,400 linear feet of 8” diameter ductile iron pipe (DIP), 11 house connections (HCS), and 17 manholes. Consumption data is provided as Appendix A. The current system has a total of 19 active connections, based on data provided by PCWMD. Those active connections are shown in Figure 1-1 below.

The sewer main is located west of Sabino Creek generally under the paved Sabino Canyon Park Road and has a slope ranging from 0.00% to 12.15%. The majority of the sewer has a 4-8% slope with one very steep and two very flat reaches near the treatment facility. Manholes are all standard 4’ diameter concrete manholes ranging between approximately 8’ – 18’ deep. The collection system terminates in the influent pump station located on the west side of Sabino Canyon Park Road immediately north of the wastewater treatment facility driveway. The pump station was constructed of pre-cast concrete rings set into a two-foot thick reinforced concrete base. The pump station working volume is approximately 1,800 gallons and is equipped with dual 5HP grinder pumps.
Details regarding the current conveyance system capacity are presented in Section 5.1.
1.4 **Treatment Facility Overview**

The current WWTF was constructed between June 1982 and May 1984. The entire treatment facility is enclosed in a 2,000 square-foot, pitched roof, glue laminate beam structured building. The building also contains an electrical control room, operators’ office, restroom, storage, and chlorine store room.

The treatment system was constructed as a below grade steel structure on a reinforced concrete poured-in-place base. The treatment system consists of an influent sampling box, oxidation ditch with an internal clarifier, chlorine contact chamber, and sludge holding tank. Wastewater is pumped from the pump station, described above, through a valve vault and five 1¼” diameter influent PVC pipes to the influent sampling box. Flow leaves the influent sampling box via gravity through a v-notch weir into the circular oxidation ditch. Air is added to the wastewater by a brush rotor to facilitate biological decomposition of the wastewater. The wastewater flows by gravity to the internal circular clarifier where quiescent conditions allow sludge to settle. Some of the settled sludge is returned as Return Activated Sludge (RAS) to the oxidation ditch, while the remainder of the sludge is pumped to the sludge holding tank as Waste Activated Sludge (WAS). All RAS/WAS pumpage is performed through air lift pumps. Clarified wastewater flows by gravity through the chlorine contact chamber into an on-site effluent pump station.

The WWTF has a permitted treatment capacity of 12,500 GPD monthly average in the USFS special use permit with a maximum peak daily flow of 17,000 GPD. Using an uncalibrated Hydromantis GPS-X model, PCWMD staff calculated the possible actual capability of the WWTF as being able to treat an average rate of flow from 20,000 GPD (winter) to 25,000 GPD (summer). The manufacturer’s rated capacity for the current plant is 15,000 GPD. This value was used as the plant capacity for regulatory timeline development associated with permitting. Typically WWTFs apply for permit amendments for expansion when flows approach 80% of current WWTF capacity. The 80% level for this plant is 12,000
1.5 **Effluent Disposal System Overview**

The current effluent disposal system was constructed between June 1982 and May 1984. Two effluent pumps draw treated effluent from the effluent pump station, described above. The water is pumped through approximately 5,200 linear feet of 4" DIP, located under the north and west side of Sabino Canyon Park Road and along the west shoulder of Mt. Lemmon Highway into the booster pump station. The booster pump station and the associated discharge fields are located on USFS property north of the Mt. Lemmon Highway and east of the Mt. Lemmon Control Road. The booster pump station is a reinforced concrete, poured-in-place structure with a maximum capacity of approximately 17,500 gallons. Integral to the pump station is a mechanical room that houses the booster pumps, electrical equipment, and appurtenances. The booster pumps convey treated effluent onto a spray disposal area immediately east of the booster pump station. The spray field/outfall area is at an elevation of approximately 7,800 ft on a northeast-facing, moderately steep slope. Six spray fields, consisting of 78 spray heads, spray treated effluent across approximately 10 acres. This spray field site is within the Alder Canyon watershed which is tributary to the San Pedro River. (Report Section 3.3). PCWMD also can discharge treated effluent through a surface discharge site to 3 outfalls located north of the spray field. These discharge to un-named washes which lead to Alder Canyon and the San Pedro River (Report Section 3.0), Figure 1-2 below.
Figure 1-2
2.0 Physical Environment

2.1 Flow Volumes
Influent flow records for the Summerhaven WWTF were provided by PCWMD as the basis for this section of the report. This section of the report addresses current and historic flows. Flow projections for redevelopment of Summerhaven are discussed in Section 8.7 of this report. Figure 2-1 shows historical average influent data from 1993 through 2006. Yearly averaged daily flows were between 4,700 GPD and 2,000 GPD, while monthly averaged daily flows fluctuated primarily between 7,000 GPC and 900 GPD. Two monthly averages, January 1993 and August 2006, had abnormally high average monthly flows, 11,500 GPD and 12,300 GPD respectively. The January 1993 flows were attributed to system inflow. PCWMD investigate the problem and found grout voids at manholes, manhole benches and the influent lift station. PCWMD also discovered a clean out cover was missing at one of the residences, allowing snow and rain to flow into the system. The August 2006 high flows were attributed to a contractor relocation of three manholes in the Sabino Canyon roadway improvement project. For over two weeks PCWMD experienced significant inflow from Sabino Creek and groundwater.

Under the conditions of the original USFS special use permit for discharge to the Spray Field and outfalls, 47 properties were designated for sewer service. These properties are numbered 1 through 47 on Figure 2-2, Mount Lemmon WWTF Original Service Connections. Just prior to the Aspen fire, 37 of the 47 properties were paying PCWMD for consumption fees, vacation rate, or standby fees. Standby fees are paid for having a sewer connection, but not using it. After the Aspen Fire, PCWMD was permitted by the USFS to provide sewer service up to a total of 77 properties. PCWMD has complete discretion for selecting which properties will be provided service. Of the additional 30 properties, three have obtained connection permits to date. Currently there are 19 properties with active sewer connections (see Figure 1-1). This is approximately the same number of active connections as before the Aspen Fire. Based on 19 connections contributing flow to the WWTF (this number originally consisted of the active lots and the comfort station, which by the time the 98% report was
written was no longer active), the yearly average flow was approximately 110 GPD per active connection.
Mt. Lemmon WWTF Average Flow

Figure 2-1

- Ave. Mo. Flow
- Plant Capacity
- Ave Yearly Flow
- Bullock Fire
- Aspen Fire

Thousand Gallons

Dec-02 Dec-03 Dec-04 Dec-05 Dec-06 Dec-07 Dec-08 Dec-09 Dec-10 Dec-11 Dec-12 Dec-13 Dec-14 Dec-15 Dec-16 Dec-17
Seasonal Flows

Generally flows at the WWTF are highest in the summer and the winter, with lower flows experienced during spring and fall. The increased summer flow is believed to be caused by an increased number weekend visitors and more people staying at cabins in Summerhaven, while the higher flows in the winter may be attributed to infiltration and inflow (I&I) from winter storms and additional winter visitors. Average flows, by month, for two time periods (1993-2006 and 2004-2006) are summarized in Table 2-1 below.

Table 2-1
Mt. Lemmon WWTF
Average Daily Flow by Month

<table>
<thead>
<tr>
<th>Month</th>
<th>1993-2006 Average Daily Flow (GPD)</th>
<th>2004-2006 Average Daily Flow (GPD)</th>
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</thead>
<tbody>
<tr>
<td>January</td>
<td>2,900*</td>
<td>2,600</td>
</tr>
<tr>
<td>February</td>
<td>3,600</td>
<td>3,100</td>
</tr>
<tr>
<td>March</td>
<td>3,700</td>
<td>2,700</td>
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<tr>
<td>April</td>
<td>3,200</td>
<td>1,900</td>
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<td>June</td>
<td>2,900</td>
<td>1,900</td>
</tr>
<tr>
<td>July</td>
<td>3,600</td>
<td>3,100</td>
</tr>
<tr>
<td>August</td>
<td>3,300*</td>
<td>2,200*</td>
</tr>
<tr>
<td>September</td>
<td>3,000</td>
<td>2,200</td>
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<tr>
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<td>1,800</td>
</tr>
<tr>
<td>December</td>
<td>2,700</td>
<td>2,100</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>3,100</strong></td>
<td><strong>2,200</strong></td>
</tr>
</tbody>
</table>

*Average flows for January 1993 and August 2006 are considered anomalies and are not included in the above data.
Weekly and Holiday Flows
Influent to the WWTF fluctuates during a normal seven-day week. Higher flows are experienced on the weekends while flows drop significantly during the weekdays. Table 2-2 illustrates that flows increase during weekends. The second column demonstrates that summer flows are significantly higher than yearly averages by a factor of approximately 40%.

Table 2-2
Mt. Lemmon WWTF
2006 Average Daily Flows* by Day of Week and Holidays

<table>
<thead>
<tr>
<th>Day</th>
<th>2006 Average Flow (GPD)</th>
<th>Summer Data 05/29-09/04</th>
<th>Memorial Day (GPD)</th>
<th>Fourth of July (GPD)</th>
<th>Labor Day (GPD)</th>
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<td>1,800</td>
<td>2,600</td>
<td>2,800**</td>
<td>3,200</td>
<td>5,900**</td>
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<td>Tuesday</td>
<td>1,900</td>
<td>2,300</td>
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<td>3,800**</td>
<td>4,400</td>
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<tr>
<td>Wednesday</td>
<td>1,700</td>
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<td>Thursday</td>
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<tr>
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<td>2,500</td>
<td>3,700</td>
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<td>6,200</td>
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<td>Sunday</td>
<td>2,500</td>
<td>3,500</td>
<td>3,300**</td>
<td>3,500</td>
<td>6,500</td>
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<tr>
<td>Average</td>
<td>2,000</td>
<td>2,800</td>
<td>3,100</td>
<td>3,500</td>
<td>5,800</td>
</tr>
</tbody>
</table>

*Flows for August 2006 are considered anomalies and are not included in the above data.
** Denotes actual day of National holiday

One of the other times the Mt. Lemmon WWTF receives higher than average flows are during summer holidays. 2006 WWTF influent flows during Memorial Day Weekend, Labor Day Weekend, and Fourth of July are shown in columns four through six on Table 2-2. The actual holiday is marked with double asterisks (**). For 2006, Labor Day weekend produced the largest holiday surge. Flows were approximately 2.9 times yearly average and 2.0 times summer averages.

Peak Flows
Tables 2-1 and 2-2 demonstrate the historic peak flows that occur at the WWTF. These peaks are generally experienced during weekends and summer holidays.
The highest peak experienced in 2006 was during the Labor Day weekend when flows between Saturday and Tuesday averaged 2.9 times the average day flow. The highest flow during the weekend was on Sunday when flows were 3.2 times the average daily flow. Overall flows during the summer were approximately 40% higher (1.4 times) than the average flow for the year. These peaks are significant as they will challenge the treatment capacity of the WWTF first. However, if PCWMD has sufficient influent equalization volume these peaks can be leveled out and metered into the system during periods of lower flow.

**Post Aspen Fire Wastewater Flows**
The Mt. Lemmon community experienced a significant fire event when the Aspen Fire occurred in June and July, 2003. The Town of Summerhaven lost approximately 70% of the structures during the fire and is rebuilding and redevelopment to recover from the two fires. Figure 2-3 displays the WWTF influent immediately after the Aspen Fire through 2006. The yearly average flow for 2003 - 2006 has been 2000 GPD, 2100 GPD, 2700 GPD, and 2100 GPD respectively. This is a very small data set to use to predict trends. However, based on this information it would appear that the WWTF influent is increasing less than 300 GPD per year. Currently the average flow per active connection is approximately 110 GPD, so a 300 GPD increase per year is equivalent to about three active connections per year.

**Comfort Station & Community Center**
Pima County has completed construction of a new Summerhaven Community Center. This public facility, located at the southwest corner of Sabino Canyon Parkway and Turkey Run Lane, opened on July 20, 2007. It will contain public restrooms, large meeting room, office and outdoor patio space. Upon completion of the Community Center, Pima County will remove the existing public restrooms. Wastewater generated at the Community Center may increase slightly due to increased usage of the center for meetings and community activities.
Figure 2-3

Mt. Lemmon WWTF Average Flow
Post Aspen Fire

- Ave. Mo. Flow
- Ave Yearly Flow

Thousand Gallons

Feb-03 Feb-04 Feb-05 Feb-06 Feb-07
Summary of Flow Requirements and Scope of Study

Flow projections for the Summerhaven area were determined using historic data for the current Mount Lemmon WWTF, information obtained from Pima County regarding the number of permitted septic systems before the fire and those that are on lots that were damaged by the fire, current number of connections, the size of homes being rebuilt, and limited information regarding proposed condominium development in Summerhaven. Flow information is described further in Sections 2.1 and 8.7 of this report. In conjunction with assessing flow, EEC evaluated options for upgrading the current WWTF within current permit flow limits (Section 5.2), expanding the WWTF as needed to meeting community needs (Section 5.2), and management of biosolids (Section 5.2). Peak flows on weekends and holidays represent a more immediate planning need than average increases in flow. Planning is needed to buffer peak flows to stay within permit limits for discharge limits on flow. Without addressing peak flows, expansion of the plant will be needed sooner than anticipated. These issues are all addressed in greater detail through this report.

Re-development of Summerhaven and resulting wastewater flow rates are also limited by availability of water supply in the area. Arizona is currently in sustained period of drought, much of the drinking water in this areas is collected in shallow radial wells located in bedrock topographic low points. Without a long term water supply and aquifer, the amount of flow that can be generated without augmentation of the Mount Lemmon water supply is limited. The water supply system and resources and how these effect redevelopment and wastewater flow is discussed in Section 2.4 of this report.

Biosolids are currently trucked off the mountain without thickening or drying. There is risk associated with transferring sludge that has not been thickened and dried by truck to manholes located in Tanque Verde. A management plan is needed for not only wastewater treatment but also biosolids handling. The biosolids handling plan should be consistent with the Pima County Regional
Optimization Master Plan (ROMP) recommendations. ROMP is a 20-year planning document designed to cultivate compliance of wastewater management systems with environmental rules and regulations.

20-year planning at Mount Lemmon should be consistent with ROMP strategies in general and should be structured to ensure compliance with environmental law, service to the community, and conserve resources for a sustainable future for the community of Summerhaven.

2.2 **On-site Wastewater Treatment Systems**

Pima County has commissioned several reports that discussed the appropriateness of on-site wastewater systems in the Summerhaven area.

- In 1975 Pima County hired Finical & Dobroski and Brown & Caldwell to prepare a Facility Plan and an environmental impact assessment for a replacement system. This study indicated the Summerhaven area is unsuitable for septic tank leach fields, sewage lagoons, and vault toilets due to minimal soil depth and the possibility of short circuiting of leach fields to Sabino Creek via fissures in the underlying rock.

- A Facility Plan addendum was prepared in 1977 by LGC Engineering Associates, Inc. The LGC Study considered septic tanks, aerobic units, ET systems, vaults and the impact of flow reduction in its scope of work. It’s significant to note that LGC considered septic tanks and ET systems and subsequently recommended a centralized wastewater treatment system.

- In September 1977, the Pima County Board of Supervisors adopted the PAG 208 Plan of the Mt. Lemmon area. The plan identified the goal of making Sabino Creek “swimmable and fishable” and recommended “No wastewater should be discharged into Sabino Creek”, and the Facility Plan “be amended to identify onsite, no-discharge wastewater treatment alternatives for each of the users” of the existing system, among other recommendations.
The Toups Corporation report tabulated annual pollutant loadings in Sabino Creek in 1977. The pollutant loading at that time from approximately 300 septic systems are as follows:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Biochemical Oxygen Demand (lbs/yr)</th>
<th>Total Nitrogen (lbs/yr)</th>
<th>Total Phosphorus (lbs/yr)</th>
<th>Fecal Coliforms per year</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Total man related pollutant input to study area</td>
<td>16,100</td>
<td>3,060</td>
<td>550</td>
<td>$3 \times 10^{16}$</td>
</tr>
<tr>
<td>B. Natural background in Sabino Creek Gauging Station</td>
<td>2,528</td>
<td>944</td>
<td>35</td>
<td>Variable</td>
</tr>
<tr>
<td>C. Nonpoint pollution of Sabino Creek at Gauging Station</td>
<td>1,260</td>
<td>88</td>
<td>92</td>
<td>$3.2 \times 10^{10}$</td>
</tr>
<tr>
<td>D. Point Discharge from Sewage Treatment Facility in Sabino Creek at Gauging Station</td>
<td>2.624</td>
<td>1,309</td>
<td>290</td>
<td>$5.5 \times 10^{11}$</td>
</tr>
</tbody>
</table>

While the non-point pollution was small compared to the discharge from the wastewater treatment facility, it should be clear that review of this 1977 study suggests that nitrogen and phosphorous contamination of Sabino Creek was occurring due to septic systems. It is expected that existing septic systems are contributing nitrogen and phosphorous loads to Sabino Creek. Septic systems and potential impact are discussed further in later sections of this report. It is interesting to note that in spite of the data, the Toup report concluded that:

- Septic tank and drain systems when operating correctly effectively remove essentially all pollutants and minimize health problems.
- Except for occasional failures septic tanks and drain systems appear to function well.
These conclusions are contrary to the findings of the EIS prepared by Finical & Dobrooski and Brown and Caldwell.

At the time nitrogen and phosphorous loading to Sabino Creek was not a concern. Today, given the SWQS established for the creek, loading of these constituents is of concern. However, in 1977, due to water quality standards and presence of endangered species in this watercourse, the recommendation was that nitrogen and phosphorous discharges should be limited and monitored.

This recommendation was based on the nonpoint source analysis by the Toups Corporation reported in June 1977. This report compared pollution contributed from non-point sources (individual septic systems) to pollution contributed by the then existing wastewater treatment facility (point source). The loads from the non-point sources were significantly less than the treatment facility, however it should be noted that the treatment facility that was in place at the time, would not be considered “state of the art”, even in 1977. Due to the Board’s approval of the PAG 208 Plan PCWMD prepared a second addendum to the Facility Plan. This addendum acknowledged that onsite disposal systems provide a better solution from financial, environmental and public opinion points of view. This conclusion was based in part on: “(1) The 208 Plan’s finding that leaching fields are generally not creating environmental problems now in Sabino Creek, and thus can be depended upon to provide a viable, inexpensive wastewater disposal method for most Summerhaven lots.”

- The second Facility Plan addendum led to the 1978 Winneberger Study and Report which supported installation of onsite septic tank and leach field systems, which “should be constructed with uncommon design and care.” The Report implied that since the soils apparently have proven capability for septic tank practices, “it only remains to find adequate area and utilize it in a practical fashion.” Dr. Winneberger’s investigative effort included several percolation tests and subsurface soil investigations of about three sites within Summerhaven.
• In July 1980, a meeting was held between ADHS and PCWMD to receive presentations from PCWMD’s consultants. The consultant’s findings were that most of the customer properties served by the existing wastewater system could not support orthodox onsite wastewater disposal system, and, therefore, recommended that (1) a community collection and disposal system be designed and installed; (2) all lots to be served be considered for connection to the new community system; and (3) a plan of action if onsite disposal was to be considered further.

• On October 22, 1980, another PCWMD subconsultant "Mr. Otis" submitted a letter report, which recommended against soil absorption systems in the area and further recommended recirculating sand filters as the treatment method.

In spite of later findings, conventional septic systems have been permitted and installed in Summerhaven (Appendix B, Summerhaven PDEQ Septic System Information). EEC reviewed these reports and also available data to assess the current status of the creek and influence of septic systems. It is important to note that the depth of soils in the study area is limited, given the presence of bedrock at or near the ground surface. Information for a total of 258 pre-fire permitted septic systems were found in PCDEQ records (13 of these have recently been replaced with Type 4 general permit on-site systems). These systems were constructed prior to new Aquifer Protection Permit general permit rules for on-site wastewater systems, which were effective in 2001. Applicable requirements for permitting on-site systems after 2001 require improved design compared to old conventional system design requirements.

Leachfields associated with old septic systems may be constructed in Summerhaven are likely to be placed in shallow soils and treatment in septic systems may be incomplete. This has lead to renewed inquiry about whether old conventional septic systems in Summerhaven have the potential to impact water quality in Sabino Creek and whether the lots in the study areas are suitable for many of the Type 4 General Permit designs in the Aquifer Protection Permit.
program. Pima County DEQ currently has reciprocity to issue Type 4 General Permits for the Arizona Department of Environmental Quality. EEC obtained Pima County information regarding permitted on-site systems in Summerhaven.

A total of 66 Type 4 permit applications have been received by PCDEQ since 2001. Of these applications for Type 4 General Permits, 52 appear to be conventional systems with leachfields (only 1 of these systems was combined with a disinfection system), 8 were for vault and haul systems, and the remainder were combination systems. Homeowners with vault and haul systems currently pay to have septage hauled to disposal sites. PCWMD may be able to receive this septage from vault system owners, for a fee.

Lots with conventional septic systems with structure loss during the fires may be available for connection to a sewer system, if available, as part of redevelopment. Section 8.3 presents additional information regarding the
number of lots that may be available for connection in the Summerhaven Sewage Planning Area, Summerhaven East and Summerhaven West.

Exhibit 1 Septic Systems shows the lots with permitted systems, lots which were damaged by the fire, lots for which Type 4 General Permit applications were submitted to PCDEQ, and identifies the original lots with conventional systems and re-certified conventional systems.

To further assess the issue of potential impact of on-site wastewater systems and old septic systems on Sabino Creek water quality, in addition to permitting data, EEC obtained available water quality records from the Arizona Department of Environmental Quality (ADEQ) database for Sabino Creek (Appendix C, ADEQ Sabino Creek Data). ADEQ has monitored 4 stations on the creek and data was available from 1989 until 2005, but samples collected by ADEQ were not analyzed consistently for all constituents of interest, nor were samples collected on a consistent basis. Also ADEQ did not collect samples upstream of Summerhaven that would allow comparison of upstream and downstream water quality. These data constraints limit the interpretative value of the data set.

One ADEQ location was at the south end of Summerhaven, one downstream at the “East Fork” of Sabino Creek, and two were located near the Sabino Canyon Recreational Area (2 “Near Tucson” sites). The monitoring points are shown in Figure 2-5, ADEQ Sabino Creek Sampling Locations. The data for the two upper points were evaluated for potential evidence of septic system impact to Sabino Creek water quality. EEC also obtained recent data from PCWMD for two points sampled in 2006: Station#3 located downgradient of Summerhaven, and Station #2 located upgradient of Summerhaven. The PCWMD sampling points are shown in Figure 2-6 Sabino Creek PCWMD Sampling Locations. Pima County sampled these points a total of 4 times in 2006 through 2007. Data for these locations were tabulated and concentrations for constituents of concern for septic system wastewater were plotted and graphed versus sampling date to allow assessment of whether impact to the Creek occurred from septic systems after
start-up of the Mt. Lemmon WWTF in 1984. The recent PCWMD for Station #3 was also graphed with the ADEQ Summerhaven data set. Copies of PCWMD Sabino Creek sampling data is provided in Appendix D.

Constituents that EEC included in the evaluation were: *e. coli*, fecal coliform, fecal streptococci, all forms of nitrogen including total kjeldahl nitrogen (indication of organic nitrogen) for which data was available, phosphorous, and dissolved oxygen (DO) and total dissolved solids (TDS). Flow at the time of sampling was plotted if this information was available. The majority of the data yielded little insight for the concern. Data for dissolved oxygen, *e. coli*, fecal coliform and fecal streptococci did provide some indication of potential impact.

EEC’s review of the data obtained from PCWMD and ADEQ indicates that pathogens (fecal coliform, and fecal strep) were routinely detected in samples collected at the sampling point located south (downstream) of Summerhaven in the data set obtained from ADEQ. Re-occurring presence of these constituents suggests potential impact from septic systems. However, firm conclusions cannot be drawn without comparable water quality data from a sampling point located upgradient of Summerhaven in the creek, since pathogens may also come from animal origin. It should be noted that *e. coli* were not detected in 3 of the 4 samples collected by PCWMD at Station #2 located upgradient of Summerhaven. *E. coli* was, however, detected in the PCWMD sample collected in December 2006 at a concentration of 61.3 colony forming units (CFU) per 100 milliliters (ml) at upstream sample location Station #2. For perspective, these levels should be compared to the current Sabino Creek full body contact (FBC) SWQS for *e. coli* of 235 colony forming units per 100 ml (CFU/100ml).
Figure 2-3 ADEQ Sabino Creek Sampling Locations

Figure 2-5
Figure 2-4 PCWMD Sabino Creek Sampling Locations

Mt. Lemmon Service Area Watershed Study & Wastewater Management Plan (Project No. 206145)

Figure 2-6
Even without upgradient water quality data for comparison it appears that pathogens were routinely detected in the upper reaches of Sabino Creek during the period that it was sampled by ADEQ. One spike in pathogen concentrations was observed at the sampling point located downgradient of Summerhaven in March 5, 1991, during a time when the flow in the Creek was reported as 9000 cubic feet per second (cfs). This is shown in the graph below.

**Figure 2-7 Graph of Sabino Creek Fecal Coliform and Strepococci Data – Below Summerhaven**

Data for March 1991 sampling event suggest that sediment loads increase during flooding, and that pathogen concentrations also increase. This may be related to several contributing factors including erosion, septic systems located in shallow soils in Summerhaven, and influence of impermeable bedrock and bedrock topography near the ground surface which may accentuate flow of wastewater from leachfields in the subsurface towards the creek under conditions in which
the soils are saturated. Further study would be needed to evaluate this possibility including upstream data for comparison and data collection during storm and flood events.

The data also indicate that in general dissolved oxygen concentrations in Sabino Creek downstream of Summerhaven are very high, close to saturation, but show a slight decreasing trend between 1990 and 2006. This suggests that observable but slight water quality impact may be occurring in the creek.

Figure 2-8 Graph of Dissolved Oxygen in Sabino Creek – Below Summerhaven

Based on the data reviewed, dissolved oxygen concentrations in all sampling locations on the Creek appear to be inversely related to TDS concentrations.

Given the limits of the available data, a consistent monitoring program is recommended to further assess possible septic tank influence downstream of Summerhaven, and also the effects of flood events on creek water quality and
the possible connection of concentrations detected during flood events with septic system impact and shallow bedrock. Upstream data is also needed for comparison.

A copy of the data provided by ADEQ and PCWMD is included in this report as Appendix E - ADEQ Surface Water Quality Data and PCWMD Surface Water Quality Data.

Type 4 On-site Wastewater Treatment Systems in Summerhaven fall under the permitting authority of Pima County ADEQ. While these systems may offer improved treatment compared to conventional septic systems, site conditions in Summerhaven may be limiting and affect whether lots in the area are eligible for Type 4 general permits for on-site systems. This is discussed further in Section 3.6 of this report and in Section 8.3.

2.3 Environmental and Wildlife Issues

2.3.1 Introduction

The study area encompasses a portion of the Sabino Creek watershed and a portion of the Upper Alder Canyon watershed in the Santa Catalina Mountains north of Tucson, Arizona. The study area includes the largely privately owned community of Summerhaven and leased and unleased Coronado National Forest land including Mt. Lemmon Ski Valley. Elevations range from approximately 3,200 feet above mean sea level in the Catalina foothills to 9,100 feet at the summit of Mt. Lemmon. Summerhaven is at an elevation of approximately 7,800 feet. Originating from springs just below Ski Valley, Sabino Creek is perennial along much of its length from the crest of the range to the foothills. The creek flows through Summerhaven southward into the Santa Cruz River watershed. Alder Canyon includes Alder Creek which is ephemeral and flows northeastward into the San Pedro River watershed.
The current Pima County Wastewater Management Department (PCWMD) wastewater treatment facility (WWTF) is located off Sabino Canyon Park Road just south of its junction with Carter Canyon Road. The WWTF site is on a moderate slope in unburned or lightly burned (a result of the 2003 Aspen Fire) mixed-conifer forest. A small intermittent stream runs along the southwestern side of the county’s property. This stream was flowing on November 17, 2006, during a site field visit. The WWTF site is within the Sabino Creek watershed.

The spray field/outfall area is at an elevation of approximately 7,800 ft on a northeast-facing, moderately steep slope just off the Old Mt. Lemmon Road (Forest Road 38). Six spray fields spray treated effluent across approximately 10 acres. This site is within the Alder Canyon watershed which is in the San Pedro Watershed. The Spray Field also contains 3 outfalls to unnamed washes which drain to Alder Canyon. These outfalls are shown in previous figure, Surface Water Quality Standard Designation.

2.3.2 Soils, Geology, and Topography
The study area is characterized by rugged topography. Bedrock exposed at the Ski Run Road/Sabino Canyon Park Road junction is Leatherwood granodiorite of Cretaceous age (Force, 2003). Further up the slopes of Mt. Lemmon pink and green marble and contact-metamorphosed skarn comprise much of the bedrock. These rocks are part of the Abrigo Formation, a carbonate sedimentary rock of Cambrian age (Force 2003). Further down Sabino Canyon toward Marshall Gulch, garnet-rich dikes are common in the Leatherwood granodiorite (Force 2003). Because of the geologically young nature of the mountains, steep topography, and cool climate, soils of the study area are commonly shallow; however, there are a few areas where in-fill has resulted in deeper soils. The absence of a thick soil layer impacts options for development of wastewater disposal fields and reclaimed irrigation options that are explored later in this report. The presence of near surface granodiorite and gneiss in outcrop and near the ground surface impacts disposal options such as recharge and injection that are explored later in this report.
Summerhaven lies in the bottom of a canyon and is surrounded by moderately steep slopes with some bedrock outcrops. Soils have become extremely susceptible to erosion following two major wildfires in 2002 and 2003. The Coronado National Forest is funding preventative measures such as grass seeding to aid in slope stabilization and reduce soil loss to post-fire related erosion.

Lower Sabino Canyon, a heavily used recreation area at the base of the Santa Catalina Mountains, was the location of mass wasting events in July, 2006, following record rainfall. At least 18 debris flows removed structures, destroyed the roadway leading into the canyon in multiple locations, and closed public access for months (USGS 2006). To the west in Rattlesnake Canyon, a similar number of debris flows coalesced to travel several miles down the channel washing out the roadway, debouching into Sabino Creek, and contributing to a net 16 to 24 feet of deposition within Sabino Creek (USGS 2006). The debris flows were followed by streamflow floods which eclipsed the record discharge in the 75-year gauging record of the canyon (USGS 2006).

2.3.3 Vegetation
The dominant habitat types in the upper Sabino Creek watershed near Summerhaven and Mt. Lemmon are Rocky Mountain Ponderosa Pine Woodland and Rocky Mountain Montane Dry-Mesic Conifer Forest and Woodland (NatureServe 2003). Ponderosa pine (Pinus ponderosa), including both three-needle and five-needle (Arizona pine) varieties, dominates the Rocky Mountain Ponderosa Pine Woodland; Southwestern white pine (Pinus strobiformus) and Gambel’s oak (Quercus gambelii) can also be common (NatureServe, 2003). Common grasses include various gramas (Bouteloua spp.) and muhlies (Muhlenbergia spp.). Rocky Mountain Ponderosa Pine Woodland is found largely on south- and west-facing slopes from 7,000 to 8,000 feet. Douglas-fir (Pseudotsuga menziesii), Southwestern white pine, ponderosa pine, white fir
(Abies concolor), and quaking aspen (Populus tremuloides) occur in the Rocky Mountain Montane Dry-Mesic Conifer Forest and Woodland (Figure 2-6) (NatureServe 2003). Common shrubs include maple (Acer spp.), New Mexico locust (Robinia neomexicana), and Gambel's oak. A wide variety of grass species can occur. Rocky Mountain Montane Dry-Mesic Conifer Forest and Woodland is common on east and north-facing slopes from 7,500 to 9,000 feet. Corkbark fir (Abies lasiocarpa v. ariz onica) is found near the summit of Mt. Lemmon on shady north-facing slopes. Arizona alder (Alnus arizonica) and willow (Salix spp.) are common along intermittent and perennial waterways. Large areas burned by the Aspen Fire in 2003 and the Bullock Fire in 2002 are now dominated by grasses and forbs. The Bullock Fire burned across the formerly forested spray field area; the area is now largely grasses and forbs with some resprouting Fendler ceanothus (Ceanothus fendleri).

The middle Sabino Creek watershed is characterized by woodlands of Arizona cypress (Cupressus arizonica), Chihuahua pine (Pinus leiophylla var. chihuahuana), various evergreen oaks (Quercus spp.), Mexican pinyon pine (Pinus cembroides), and various juniper (Juniperus spp.) species from 5,500 to approximately 6,500 feet (Figure 2-9). Slightly lower in elevation chaparral, dominated by canyon live oak (Quercus turbinella), and some grassland and oak savanna occurs from approximately 4,000 to 5,500 feet. The lower Sabino Creek watershed at the base of the mountains and in the foothills, from approximately 2,800 feet to 4,000 feet, is characterized by Sonoran Desert scrub (Figure 2-9). Common species include saguaro (Carnegiea gigantea), palo verde (Parkinsonia microphyllum), jojoba (Simmondsa chinensis), and cholla and prickly pear cacti (Opuntia spp.). Fremont cottonwood (Populus fremontii), Arizona sycamore (Platanus wrightii), and various willows (Salix spp.) form riparian habitat in lower Sabino Canyon (Figure 2-9).

The type of vegetation present in the study area is relevant to options for reclaimed irrigation of areas as part of post-fire recovery and rehabilitation.
Information about native species is useful in assessing plants that may be grown with reclaimed water in post-fire recovery efforts and actions that may be taken to stabilize surface soils after the fire. After fires, vegetation losses result in enhanced erosion and high sediment loads in stormwater runoff. Increased sediment in stormwater causes loading in creeks that can be deleterious to aquatic wildlife. All of these factors should be considered as options such as use of reclaimed water for irrigation are evaluated.
Figure 2-9 (a–f). Photographs clockwise from top left: (a) Sonoran Desert scrub; (b) Chihuahua Pine, a rare species in the United States; (c) Mexican spotted owl (USFWS photo); (d) view from the Catalina crest; (e) Sabino Creek (U of A photo); (f) mixed-conifer forest.
Noxious Weeds and Invasive Plants

Noxious weeds in Arizona are those species that are “…liable to be, detrimental or destructive and difficult to control or eradicate…” (ARS § 3-201). While small populations of designated noxious weeds occur on the Coronado National Forest, a more significant problem is with invasive exotic species. Federal and state laws generally define noxious weeds in terms of interference with commodity uses and economic impacts; however, the impact of invasive exotic plants on ecosystem processes such as hydrology, fire frequency and plant productivity is a growing concern. Since the Coronado National Forest was established in 1908, invasive plants have increased in numbers and distribution across the Forest. Invasive exotic plants include noxious weeds (e.g., yellow star thistle), but also include numerous other plant species that cause detrimental changes to native ecosystems.

While the Coronado National Forest does not have a severe problem with noxious weeds, there are small infestations of invasive exotic species (Coronado National Forest 2006). One invasive exotic, Lehmann’s lovegrass (Eragrostis lehmanniana), is particularly common. The initial survey for the Santa Catalina Mountains is not complete but several invasive plants have been identified. All known populations on the Coronado National Forest occur at the lower elevations with the exception of the populations of Canada thistle, which have been found in the Pinaleno Mountains at elevations above 8,500 feet. The Pusch Ridge Wilderness in the Santa Catalina Mountains is significantly affected by infestations of invasive plants; buffelgrass and fountain grass are spreading throughout the canyons at lower elevations (Coronado National Forest 2006).

This discussion of invasive plant species is relevant to options for disposal and reclaimed use of treated effluent. Current discharge to the spray fields is disposal and is non discerning in terms of the types of species that may be growing in response to the discharge. Options for planned reclaimed irrigation
should include steps to enhance recovery of native species and avoid enhancing growth of invasive species.

2.3.4 Wildlife

The Sky Island complex of southeastern Arizona, southwestern New Mexico, and northern Sonora and Chihuahua (see section 6.1), which includes the Santa Catalina Mountains, is notably diverse in terms of wildlife. About 265 bird species occur within the region; about 30 are of subtropical origin and have their northern limits within the Sky Island complex (Warshall n.d.). The sky islands are the most diverse area in the United States for mammals; some 90 native mammals inhabit the area from the chaparral community to higher elevations and at least six of these are endemic subspecies (Warshall n.d.). Some mammals that are typical of ponderosa pine and mixed conifer forests in southeastern Arizona and that likely occur in the Summerhaven area include black bear (Ursus americanus), mountain lion (Felis concolor), mule deer (Odocoileus hemionus), whitetail deer (Odocoileus virginianus), shrews (Sorex spp.), chikaree, cottontail rabbit (Sylvilagus floridansus), chipmunks (Eutamias spp.), porcupine (Erethizon dorsatum), squirrels, and vole (Microtus spp.) (Brown 1994). Band-tailed pigeon (Columba fasciata), turkey, and flammulated owl (Otus flammmeolus) are among the avian species likely present (Brown 1994).

Biological corridors are landscape features that connect large tracts of isolated habitat (natural core areas) across fragmented terrain; movement of wildlife occurs through these linkages. Wildlife activities within these corridors include foraging movements, seasonal migrations, and dispersal of juveniles. Additionally, the resultant connectivity between natural core areas fosters genetic exchange among wide-ranging plants and animals, helping to maintain viable populations, while maintaining migratory pathways in times of environmental change (Sky Island Alliance 2006). For many land animals riparian habitat provides corridors that facilitate movement between sky island ranges. Eleven selected priority habitats and corridors were identified in the Sonoran Desert.
Conservation Plan (SDCP) for Pima County, including Sabino Canyon and the San Pedro River (SDCP 2006). Corridors can be extrapolated between the Santa Catalina Mountains and other wildlife habitat, such as the Rincon, Tortolita, Tucson, and Santa Rita Mountains, using the San Pedro River, Pantano Wash, and other riparian corridors (SDCP 2006).

2.3.4.1 Federally Listed Threatened and Endangered Species and State-listed Species of Concern

When assessing site development for either disposal of treated effluent or reclaimed uses, it is important to keep in mind how land development may affect or be limited by threatened and endangered species. Several federally listed threatened or endangered species and state species of concern occur or potentially occur in the study area. One of these, the Mexican spotted owl, is present in mixed-conifer forests atop the Santa Catalina Mountains. The U.S. Fish and Wildlife Service has delineated some portions of the upper Sabino Creek watershed as Designated Critical Habitat for the owl. Also of note is the presence of the warmwater native Gila Chub in lower Sabino Canyon. In 1999, the Arizona Game and Fish Department (AGFD) reintroduced the fish in the lower portions of Sabino Creek through the Sabino Canyon Recreation Area. Table 2-4 shows the threatened or endangered species and state species of concern that occur or potentially occur in the study area.
### Table 2-4.
**Threatened and Endangered Species and State Species of Concern that potentially occur in the study area (AGFD 2006)**

<table>
<thead>
<tr>
<th>Name</th>
<th>Common Name</th>
<th>ESA</th>
<th>USFS</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Accipter gentilis</em></td>
<td>Northern Goshawk</td>
<td>SC</td>
<td>S</td>
<td>WSC</td>
</tr>
<tr>
<td><em>Allium gooddingii</em></td>
<td>Goodding Onion</td>
<td>SC</td>
<td>S</td>
<td>HS</td>
</tr>
<tr>
<td><em>Strix occidentalis lucida</em></td>
<td>Mexican Spotted Owl</td>
<td>LT</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td><em>Choeronycteris Mexicana</em></td>
<td>Mexican Long-tongued Bat</td>
<td>SC</td>
<td>WSC</td>
<td></td>
</tr>
<tr>
<td><em>Falco peregrinus</em></td>
<td>American Peregrine Flacon</td>
<td>SC</td>
<td>S</td>
<td>WSC</td>
</tr>
<tr>
<td><em>Leptonucteris curasoe yerbabuenae</em></td>
<td>Lesser Long-nosed Bat</td>
<td>LE</td>
<td>S</td>
<td>WSC</td>
</tr>
<tr>
<td><em>Listera convallarioides</em></td>
<td>Broadleaf Twayblade</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Malaxis tenuis</em></td>
<td>Slender Adders Mouth</td>
<td></td>
<td></td>
<td>SR</td>
</tr>
<tr>
<td><em>Platanthera limosa</em></td>
<td>Thurber’s Bog Orchid</td>
<td></td>
<td></td>
<td>SR</td>
</tr>
<tr>
<td><em>Rana yavapaiensis</em></td>
<td>Lowland Leopard Frog</td>
<td>SC</td>
<td>S</td>
<td>WSC</td>
</tr>
<tr>
<td><em>Sigmodon ochrognathus</em></td>
<td>Yellow-nosed Cotton Rat</td>
<td>SC</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Viola umbraticola</em></td>
<td>Shade Violet</td>
<td></td>
<td></td>
<td>S</td>
</tr>
<tr>
<td><em>Gila intermedia</em></td>
<td>Gila Chub</td>
<td>LE</td>
<td>S</td>
<td>WSC</td>
</tr>
</tbody>
</table>

**Notes:**
- ESA = Endangered Species Act, SC = species of concern, LT = listed threatened,
- LE = listed endangered, S = sensitive, WSC = wildlife of special concern, HS = highly safeguarded, SR = salvage restricted
- * Designated Critical Habitat

When considering petitioning ADEQ to revise rules and lift the prohibition on discharge to Sabino Creek, it is important to keep in mind that the creek is habitat for an endangered species of fish. The Gila chub (*Gila intermedia*) is an important native fish of the Sabino Creek watershed that is federally listed as an endangered species. It is of particular interest and importance in this study as any change to the quality or amount of water in Sabino Creek could affect the chub, whether beneficially or negatively. The chub is often associated with
cienegas and deep pools in smaller headwater streams provided with dense vegetative cover (PAG 2002). The AGFD has recommended that all existing Gila chub populations be identified, protected, and monitored. It has been found that a reduction of land erosion, preservation of habitat, and stream improvement structures on some sites can benefit Gila chub populations. The removal of nonnative fish species from historic habitat areas, such as has occurred in lower Sabino Canyon, has increased the survival rates of vulnerable juveniles (PAG 2002).

In 1999, the Arizona Game and Fish Department (AGFD) renovated the lower portions of Sabino Creek through the Sabino Canyon Recreation Area. The renovation focused on removing non-native species and restoring Gila chub populations. Gila chub were captured and transported up stream in the Sabino watershed. Game species such as trout have occasionally been stocked in the Sabino Creek watershed from the 1970s until the early 1980s, when stocking ceased. These non-native fish species were removed from the stream through poisoning. The Gila chub has migrated back down stream through flood events to populate this section of the watershed (Don Mitchell, AGFD, personal communication, December 19, 2006).

Therefore, in planning post fire recovery and wastewater management, efforts and steps taken should be supportive of native species, especially those that are threatened and endangered. Site specific information and baseline studies will be needed in support of the National Environmental Policy Act requirements that are discussed further later in this report and will apply for any use of USFS land. Planning associated with discharge of wastewater to an outfall to Sabino Creek must include studies as needed to support the NEPA process to address potential impacts, even if positive, on the endangered species of fish living in Sabino Creek.
2.3.5 Archeological and Historical Resources

There is a possibility that archeological resources occur in the study area. Few archeological surveys have been performed in the Summerhaven area. Therefore, the potential for archeologic finds is relatively unknown, though many ancient civilizations tended to live at lower, more inhabitable elevations with more moderate weather. Archeological surveys would be needed prior to construction or development of new areas. A determination of location and extent would be necessary if any construction associated with expansion of the current WWTF to extend beyond the current footprint or property boundaries, or if a new WWTF at a new location were planned. A survey of the possibly impacted area is recommended as required for compliance with Section 106 of the National Historic Preservation Act. These sorts of surveys may also be required under NEPA for use of Coronado National Forest that involve construction or clear cutting. Additional information regarding the NEPA process is provided in Section 3.0 of this report.

Historic Structures

Some historic structures occur in the study area, notably the Civilian-Conservation-Corps-era General Hitchcock Highway. A determination of the location and extent of historic structures would be necessary if any construction associated with a new facility at a new location were proposed or if the current WWTF were expanded beyond the current footprint and property boundaries. A survey of the possibly impacted area is recommended as required for compliance with Section 106 of the National Historic Preservation Act. These sorts of surveys would likely be required as part of NEPA for development of a new disposal or reclaimed irrigation sites using USFS land.

2.3.6 Visual Resources

Visual resources in the study area include forested slopes and canyons and long scenic vistas from roads and rock outcrops. Visual resources have been dramatically altered in recent times by the Aspen and Bullock Fires and over time
by the continued growth of Tucson. Long-range vistas from viewpoints along the General Hitchcock Highway and Ski Run Road and from trails and rock outcrops are increasingly impaired by pollutants from a wide variety of sources. In the immediate study area, the 84,000-acre Aspen Fire of 2003 burned a significant portion of the Summerhaven community and large tracts of adjacent National Forest land. What was once a community of 1950s- and 1960s-era cabins nestled beneath a canopy of pines is now populated fewer but generally larger structures in a partially open valley covered with grasses (Figure 2-10). Areas that were green forest prior to the fire have in many areas been converted to blackened trunks. According to a Pima County report entitled “Fire on the Mountain: the Aspen Fire” a total of 600 pre-fire structures were reportedly present (Appendix F). The fire destroyed 324 homes and damaged 5 (Pima County Public Works, 2004). The rebuilding of Summerhaven continues today.

The WWTF is on a still-forested tract of land located at the southern end of the community and is not readily visible to the public as it is tucked up on a small slope and surrounded by trees. The Mount Lemmon WWTF in Summerhaven was not damaged in the fire. The Bullock Fire of 2002 burned a swath of forest where the spray field and outfalls are located. The fire reached the area of the spray field and outfalls and currently just charred trunks still stand, though the fire remained in the understory just east of the site where earlier thinning had reduced fuels (Steve Hensel, USFS, personal communication November, 17 2006). There is a wide-ranging view eastward from the road accessing the spray fields that may actually have been enhanced by the burning of the forest immediately down slope (Figure 2-10).

The visual landscape was greatly altered by the fires. Stakeholders have expressed interest in enhancement of visual resources as part of post-fire recovery and wastewater management at Mount Lemmon. This was considered in the evaluation of options for disposal and reclaimed use of treated effluent.
Figure 2-10 (a–e). Photographs clockwise from top left: (a) burned forest following the Aspen Fire of 2003; (b) recreation is an important resource of the Summerhaven area and the Catalina Highway; (c) cabin in Summerhaven; (d) the upper Sabino Canyon watershed showing the summit of Mt. Lemmon, ponderosa pine woodland, and slopes burned by the Aspen Fire; (e) expansive vistas such as this one toward the San Pedro River are an important visual resource of the area.
2.3.6 Current, Probable, or Potential Environmental Issues

There are a number of current, probable, or potential environmental issues related to wastewater treatment and discharge on Mt. Lemmon. Of these, the quality of Sabino Creek water and that of the treated effluent are perhaps the most important environmentally and are directed related to options for reclaimed use and disposal of treated effluent.

Surface Water Quality and Options for Treated Effluent - Point source discharges are managed through the Arizona Pollutant Discharge Elimination System (AZPDES) program. The AZPDES program uses Arizona Surface Water Quality Standards (SWQS) found in Arizona Administrative Code (AAC) Title 18, Chapter 11 for watersheds in the state and according to designated uses of watersheds to establish permit conditions for facilities such as a wastewater treatment facility.

The current spray field discharges to the San Pedro Watershed and standards for an effluent dominated water (EDW) apply to this watershed. In comparison to the San Pedro Watershed, Sabino Creek has the following designated uses: domestic water source, fish consumption, full-body contact, agriculture-livestock water supply, and aquatic and wildlife (both coldwater [in upper Sabino Canyon] and warmwater [in lower Sabino Canyon]). These designations and standards are discussed further in Section 3.3 of this report.

It should be mentioned that Pima County has developed two documents that are relevant to this study entitled “Water Quality Requirements of Native Aquatic Species in Pima County” dated March 2002 and “The Water Quality of Priority Streams in Pima County”, dated April 2002, prepared by Pima Association of Governments for the Pima County Comprehensive Plan and Sonoran Desert Conservation Plan. These documents were reviewed but contained no additional or revised standards for Sabino Creek for protecting native aquatic species and simply referred to the Arizona Surface Water Quality Standards (SWQS) and the 208 Certified Area-wide Water Quality Management Plan requirements.
Additional information was found which suggests that the combined effect of copper and zinc may be not only deleterious but also synergistic.

The Arizona Department of Environmental Quality also has Reclaimed Water Quality Standards (Arizona Administrative Code Title 18, Chapter 11, Section 3) which regulate application and quality of treated effluent for direct reuse. Classes of reclaimed water, APP permitting and upgrades to the WWTF to achieve reclaimed classification improvement are discussed further in Section 3.4 of this report.

Prohibition on Discharge of Wastewater to Sabino Creek - Currently Arizona Administrative Code Title 18, Chapter 11, Section 123 states that “the discharge of treated wastewater to Sabino Creek is prohibited,” though there could be some benefits to the watershed if this were to be allowed. In reconsidering this rule, a major concern is whether or not treated effluent would meet the numeric standards for pollutants applicable to Sabino Creek. These issues are discussed further in Section 3.0 of the report.

Use of Treated Effluent to Enhance Sabino Creek Baseflow - Concerns with use of treated effluent to enhance base flow in Sabino Creek include nutrient loading, possible pathogens and other pollutants that may not be anticipated and could be harmful to wildlife and recreational users, and public perception of discharging treated wastewater into the popular creek. Current standards and uses of the creek result in the need to treat effluent to not only meet Aquifer Protection Permit Best Available Demonstrated Control Technology new facility treatment performance standards as required for plant modifications, but also possibly result in the need for additional treatment for constituents that are elevated in influent such as copper and zinc. It should be noted that if treated effluent is discharged to Sabino Creek to improve base flow that PCWMD may be committed to maintaining baseflow in the creek to support threatened and endangered species. If discharge is ceased once this base flow is enhanced, it
may cause issues for the very T&E species that the baseflow was increased to support.

Augmenting in-stream flow with treated effluent could possibly benefit fisheries, riparian habitat, wildlife, and recreation and could restore the hydrologic balance while preventing further watershed withdrawals. However, there may be risk management issues associated with committing to this direct discharge to Sabino Creek. Treatment standards that would be required to meet surface water quality standards are discussed further in Section 3.3 of the report.

Environmental Effects of the Current Water and Wastewater System - Elevated copper and zinc levels found in influent to the WWTF have been and have the potential to impact water quality in Sabino Creek if not removed through either source control or enhanced treatment at the WWTF.

Copper is regulated in drinking water as a secondary contaminant and drinking water should contain less than the action level of 1.3 mg/l. This action level is not enforcable. Zinc is regulated as a secondary contaminant and drinking water should contain less than 5 mg/L. This information is relevant since the upper reaches of Sabino Creek are designated for drinking water source use. The natural chemistry of the rocks in the region may be contributing elevated levels observed in WWTF influent and also in Sabino Creek during flood events. The source of these constituents needs to be further understood and assessed as part of implementing wastewater management plans.

Post-fire Impacts, Influent and WWTF Discharge Quality - The Aspen Fire in 2003 charred more than 84,000 acres; the Bullock Fire in 2002 burned more than 31,000 acres. Summerhaven was in the middle of both fires. The fires resulted in loss of structures/homes and the number of permanent residents in the community dropped by approximately 30 percent. After the fires, the Mt. Lemmon WWTF experienced additional inflow and infiltration (I&I) related to post-fire increased runoff and sediment loading and other possible fire-related
effects. The impact of I&I was not only observed in the influent flow rate to the WWTF but also in the quality of the influent. Post-fire flow rates peaked at 10,200 GPD in January 2005. In response to additional and unexpected I&I, PCWMD increased influent and effluent sampling efforts to assess impact of the influent on treatment and discharge quality.

Influent metals concentrations of copper, chromium, lead, magnesium, nickel, silver, and zinc reached the highest observed values in July and August of 2005 during periods when infiltration into the system were still above normal. Graphs of metals concentrations are provided below to illustrate the post-fire effects on influent quality, spiking concentrations, and the trends since 2005. Tables containing the Mount Lemmon WWTF influent and effluent data are presented in Appendix G.

![Figure 2-11 Influent Cr Concentrations (µg/L) vs. Time](image)
Figure 2-12 Cu Concentrations (µg/L) vs. Time

Figure 2-13 Influent Pb Concentrations (µg/L) vs. Time
Figure 2-14 Influent Mg Concentrations (µg/L) vs. Time

Figure 2-15 Influent Ni Concentrations (µg/L) vs. Time
Figure 2-16 Influent Silver Concentrations (µg/L) vs. Time

Figure 2-17 Influent Zinc Concentrations (µg/L) vs. Time
On July 28, 2005, influent copper concentrations spiked at 150.6 µg/L and zinc at 1257µg/L. The concentration of copper in treated effluent rose to a high of 33.89 µg/L on May 13, 2005 and was at 11.52 µg/L in the March 2007 sampling event. Zinc concentrations in effluent rose to a high of 459.8 µg/L on November 15, 2005 and dropped to 313 µg/L in March 2007.

Although influent metals concentrations have decreased since August of 2005, it should be noted that prior to the fires, zinc and copper concentrations had the possibility of exceeding the receiving water concentrations for effluent dependent waters in the San Pedro basin, as indicated in the USEPA National Pollutant Discharge Elimination System (NPDES) permit that preceded the current AZPDES permit. The NPDES permit renewal application dated April 28, 1999 submitted by Pima County included data for a reasonable potential analysis for metals and other constituents, including copper and zinc. At the time, the highest value of copper reported was 66 µg/L (compared to the Aquatic & Wildlife effluent dependent water standard in place at the time for the receiving water body of 39 µg/L using a hardness of 400 mg/L) and the highest value of zinc was 173 µg/L (compared to the Aquatic & Wildlife effluent dependent water standard of 343 µg/L). That permit was administratively extended/continued on May 15, 1999, prior to expiration. At that time monitoring requirements for copper and zinc were added to the permit without discharge limitations – in recognition of the concentrations present at the time.

Concentrations of copper and zinc in the influent and discharge have decreased since the August and July 2005 period, but are still above pre-fire values. If concentrations cannot be controlled at the source, additional treatment will be needed at the WWTF to support possible uses or discharge options for the treated effluent.

The AZPDES permit issued by ADEQ for the Mount Lemmon WWTF in December 2006 has variances for both copper and zinc for discharge quality. The permit contains interim discharge limitations. The interim daily maximum
discharge limitation for copper in the AZPDES permit is 50 µg/L. The interim discharge limitation for zinc is 270 µg/L.

The exact source of these two metals in influent is unknown but may in part come from sources such as galvanized piping in the water system and storage tanks, new home construction, or possibly ambient groundwater and surface water, based on soil concentrations and rock formations in the Summerhaven area. Data available through ADEQ for the Mt. Lemmon community water system (the Mount Lemmon Water Improvement District or MLWID) does not include analysis of samples for copper and zinc and pre-fire records were lost in the fires.

These constituents are not part of the normal sampling suite for the water system and required reporting to ADEQ. Copper has an action level of 1.3 mg/L which is not an MCL and a secondary standard of 1.0 mg/L (USEPA, 2003). Zinc has a secondary standard of 5 mg/L (USEPA, 2003). Since these levels are not primary maximum contaminant levels (MCLs) for drinking water, they are not enforceable for drinking water systems and are often not included in sampling suites. Therefore additional data was not available through the ADEQ Drinking Water Section. Further MLWID historic records were lost in the fires, therefore past data that may have provided insight on water supply concentrations has been lost. This is a data gap. An assessment of the water system for these constituents is recommended to assess if source control upgrades may be needed to reduce concentrations in influent. Additional studies are also needed to assess ambient concentrations of these constituents in sediments in surface water and in springs and collection systems used for drinking water. This data may be needed to support site specific standards if PCWMD decides to petition ADEQ for these based on procedures in proposed draft rule. If these concentrations cannot be reduced in the drinking water supply, the additional treatment will likely be needed at the upgraded or expanded WWTF to reduce
concentrations to ranges that meet Surface Water Quality Standards in support of discharge options.

It is worth noting that hexavalent chromium was detected in drinking water supplied by the MLWID at a concentration of 1.5 µg/L post-fire in May of 2004, and this concentration is the same order of magnitude as levels detected in influent and effluent post-fire, suggesting there may be a correlation with influent water quality and ambient groundwater quality. Pima County Wastewater Management is currently assessing sources of these constituents in an effort to control influent quality to ensure compliance with permit limits and assessing future discharge options as a part of this study. As indicated above, additional data should be requested from the MLWID to assess concentrations of secondary standard constituents in the water supply and water storage system and should also be collected by PCWMD.

Treated effluent discharged from the current WWTF exceeds standards in the current AZPDES permit for several constituents, these are discussed in detail in Section 3.3. Further, the quality of the effluent does not meet treatment performance standards for new facility Best Available Demonstrated Control Technology (BADCT) for trihalomethane reduction, pathogen reduction, metals discussed above, nor does it meet the surface water quality standards for Sabino Creek that will apply if the prohibition is lifted and discharge is directed to the Creek rather than the current spray field. This means that upgrade of the WWTF to achieve improved treated effluent quality is important to enhance options for discharge and disposal of the effluent and for compliance with applicable environmental programs. These issues are discussed further in Section 3.0 of this report.

Water Allocation and Protection of Water Resources - In addition to water quality, water allocation is a significant environmental issue. Currently water originating in the Sabino Creek watershed that enters the wastewater facility ultimately is discharged into a separate watershed, that of Alder Canyon which drains
eastward into the San Pedro River watershed. This leaves less water for the Sabino Creek watershed for beneficial uses such as in-stream flow, wildlife habitat, and recreation. The United States Forest Service (USFS) would prefer that Sabino Creek water and water from this watershed be retained in the Sabino Creek watershed which is tributary to the Santa Cruz Watershed for a variety of reasons (Steve Hensel, USFS, personal communication November 17, 2006). If the current WWTF is expanded to increase its capacity in response to flow and the USFS special use permit was amended to accommodate the increased flow, this would result in even more water discharged into the Alder Canyon watershed which is part of the San Pedro Watershed. This would leave even less water available for the Sabino Creek watershed. Therefore, as part of resource management, a high value has been placed in this study on identifying alternatives that would return the water to the watershed of origin or use the reclaimed water for beneficial uses such as fire fighting or reforestation to enhance the visual resources of the area or use the treated effluent for beneficial uses.

Continued Reliance on Septic Systems in Summerhaven - Faulty septic systems could readily impact public health and safety, air quality, water quality, and visitor use in the study area. As late as the 1970s raw sewage was being released directly into Sabino Creek (Steve Hensel, USFS, personal communication November 17, 2006). Since that time, construction of the WWTF has improved the quality of water that is being discharged into the watershed but sewage releases from individual conventional septic systems in Summerhaven still occur. The continued reliance on conventional systems and even newer individual on-site wastewater treatment systems is of concern in terms of resource management and protection of local springs and Sabino Creek. This is discussed further in Section 3.0 of this report.

Post-fire Stabilization - Fire damage, and the resultant loss of vegetative cover, has impacted visual resources, soils, water quality, and vegetation. The steep
slopes, shallow soils, loss of vegetative cover, and periodic heavy rains all combine to make the area highly susceptible to significant erosion, including major mass-wasting events such as rock slides and debris flows (see section 2.3.2). Development of beneficial use options that would reduce erosion and stabilize areas such as use of reclaimed water for consumptive use irrigation is a desirable goal for planning and is responsive to stakeholder input.

Development of Contingencies - Emergencies and contingencies are a concern of the Summerhaven community. A shutdown and major repair of the WWTF could prevent adequate treatment of wastewater and current storage capacity may not be adequate. Portions of the General Hitchcock Highway are susceptible to rock slides (Steve Hensel, USFS, personal communication 11/17/06) or wash outs. Closure of the highway could possibly prevent solid biosolids from being trucked down which is a current practice. Further, trucking of biosolids that have not been thickened and dewatered is a environmental risk in the event of accidents. The power supply or emergency phone lines in Summerhaven could be knocked out for some period of time. As options for the WWTF as considered, these issues must also be considered.

Post-fire Redevelopment Trends - Land use and water use trends associated with continued posts-fire redevelopment in the study area are significant considerations and the impetus for the development of this plan. According to the Pima County Wastewater Management Department, of the 30 units tied into the current wastewater treatment system, a total of 19 are active today, and just 13 of these are considered “full-time” users; the others are considered “part-time” users. If the majority or all of these “part-time” users converted to “full-time” use for year round residency and larger homes are constructed with greater flow per day per household, then the capacity of the current system may be reached earlier than anticipated. The type 4 general permit on-site systems that have been installed after the fires are permitted for larger average daily flows that the typical flows per household before the fire. The new systems are designed for
average flows between 300 and 750 gpd. Seventeen other units have requested to be a part of the system and the design flow of these lots is not yet known.

The trend towards larger homes could lead to an increased in-flow to the Mount Lemmon WWTF and stress the system, and perhaps more frequent and costlier repairs and maintenance. This observed trend also could result in excessive in-flow and exceedance of the system’s capacity on a regular basis that, without adequate storage or off-site conveyance, could lead to exceeding the WWTFs treatment capacity. It is thought that in the future the demand to be linked into the system may exceed the system’s capability and the number of lots with homes destroyed in the fire that were previously on conventional septic systems that might be connected to the WWTF should be considered in planning efforts.

Lot Size and Availability - Development or construction for larger scale wastewater system options may have to occur on USFS land, if a plant cannot be sized to fit on the small lot of land owned by Pima County and part of the County owned lot located directly south. Summerhaven is fairly small and private land in the area is very difficult to obtain and is steeply sloped with only a thin veneer of soils over bedrock, making development difficult. Some environmental issues that would have to be addressed if the county were to lease additional land from the Coronado National Forest under a special use permit for disposal or development include many of those discussed here, including effects to soil, vegetation, noise, visual resources, archeological resources, water quality, and threatened and endangered species (most importantly the Gila chub which occurs in Sabino Creek). Surveys and additional studies would be needed to support requests for use of USFS land and meet NEPA requirements if a Categorical Exclusion does not apply. This is discussed further in Section 3.0.

The community of Summerhaven and the Sabino Creek watershed are uncommon and important resources. A number of environmental laws and issues need to be addressed in formulating a long-term solution for the Mt. Lemmon Service Area wastewater system and these are discussed further in
Section 3.0. A more detailed discussion of regulatory requirements including NEPA can be found in Section 3.0 of this report.

2.4 Water Resources

2.4.1 WATER SOURCES

Table 2-5 provides a list of all ADWR registered wells in the Summerhaven area. The well locations are shown on Figure 2-18 Project Watershed Hydrology. Six domestic water supply wells in the area provide water to homes. The majority of the wells are located west of Summerhaven and in Ski Valley. However, one well is located at the southern end of Summerhaven.
### Table 2-6: ADWR Registered Wells

| Reg. ID | Township, Range, Section | Acre 160 | Acre 40 | Acre 10 | Well Use | Water Use | Install Date | Well Depth (ft) | Water Level (ft) | Casing Type | Casing Depth (ft) | Casing Width (in) | Pump Rate (gpm) | Test Rate (gpm) | Drawdown (ft) | Company/Owner |
|---------|---------------------------|----------|--------|--------|----------|-----------|--------------|----------------|----------------|-------------|----------------|----------------|----------------|----------------|--------------|--------------|---------------|
| 202146  | 11S,15E,25 NE SW SE WP DOM |          |        |        |          |           |              | 0              | 0              | 0           | 0              | 0              | 0              | 0              | 0            | Mayo         |
| 805250  | 11S,15E,25 SW NE SE WP DOM |          |        |        |          |           |              | 6/30/1974     | 45             | 0           | S              | 45             | 2              | 1              | 0            | MLDW         |
| 805251  | 11S,15E,25 SW NE SE WP DOM |          |        |        |          |           |              | 6/30/1974     | 19             | 0           | S              | 19             | 2              | 1              | 0            | MLDW         |
| 506387† | 11S,15E,25 SW NE SE WP DOM |          |        |        |          |           |              | 10/28/1983    | 100            | 16          | P              | 100            | 8              | 0              | 0            | CNF          |
| 805248  | 11S,15E,25 SW NE SE WP DOM |          |        |        |          |           |              | 6/30/1974     | 200            | 0           | S              | 200            | 2              | 2              | 0            | MLDW         |
| 903900  | 11S,15E,25 SE NE NE WP DOM |          |        |        |          |           |              | 0              | 0              | 0           | 0              | 0              | 0              | 0              | 0            | Mosher       |
| 201711  | 11S,15E,25 SE NE NW WP DOM |          |        |        |          |           |              | 0              | 0              | 0           | 0              | 0              | 0              | 0              | 0            | Davies       |
| 801691  | 11S,15E,26 SE SE NW WP DOM |          |        |        |          |           |              | 0              | 0              | 0           | S              | 0              | 4              | 2              | 2            | CNF          |
| 618599  | 11S,15E,36 NE WP IRR 1/1/1900 |          |        |        |          |           |              | 50            | 30            | 0           | 0              | 0              | 0              | 0              | 0            | Hart T       |
| 618597  | 11S,15E,36 NE WP IRR 1/1/1900 |          |        |        |          |           |              | 10            | 30            | 10          | O              | 10             | 0              | 0              | 0            | Hart T       |
| 624209  | 11S,15E,36 NE NE NE WP DOM |          |        |        |          |           |              | 8/1/1947      | 20             | 10          | 20            | 10             | 20             | 20             | 20           | Cote         |
| 583775  | 11S,16E,30 SW SW NE WP MUN |          |        |        |          |           |              | 60            | 30            | 60          | P              | 60             | 5              | 0              | 0            | MLDW         |
| 649034  | 11S,16E,31 SW NW NW WP DOM |          |        |        |          |           |              | 1/1/1948      | 12            | 3           | O              | 12             | 36             | 25             | 25           | Havhurst     |

†Submersible Pump

WP=Water Production
DOM=Domestic
IRR=Irrigation
MUN=Municipal
S=Steel-Perforated or slotted casing
P=Plastic or PVC
O=Other-Black Steel-Iron-Seamless
CNF=Coronado National Forest
Hart T=The Hart Trust
MLDW=Mount Lemmon Domestic Water
Source Water Supply Description

Water resources in the Mt. Lemmon area are limited within the Upper Sabino Creek Watershed. Water supplies in the region are sourced primarily by spring flow along Sabino Creek and associated tributaries (Peters and Bales, 2001). Groundwater is accessible in the shallow alluvium deposits, as well as in fractured portions of the bedrock aquifers.

Mount Lemmon Water Improvement District

The Mount Lemmon Water Improvement District (MLWID) supplies community drinking water and relies mostly on spring water as their drinking water source. MLWID has rights for use of this water (Boyle, 2007).

There are catchments located at Upper Sabino Spring, Pigeon Spring, Cold Spring and Carter Canyon Spring. There are three horizontal wells identified as Pigeon Well 200 (200 feet total depth and ADWR registration number 55-805248), Pigeon Well 45 (45 feet total depth and registration number 55-805250), and Pigeon Well 19 (19 feet total depth and ADWR registration number 55-805251). The Pigeon wells are constructed of 2-inch perforated steel pipe installed horizontally in the water producing hillside above Pigeon Spring. These horizontal wells produce between 5 and 20 gallons per minute (gpm). The Upper Sabino Spring produces between 5 to 35 gpm. Pigeon Spring produces between 4 to 8 gpm. Cold Spring produces between 2 to 8 gpm.

MLWID has a 60-foot deep vertical well in the right-of-way of Sabino Canyon Parkway that pumps 5 to 10 gpm. The vertical well is not normally operated, but used for backup, if required. MLWID have existing water rights to three additional springs: Wren, Junco and Conlon. These are not used and flow rates have not been established for these springs.
The table below summarizes the production rate capability of the MLWID springs and wells. The locations of these wells and springs are shown in Figure 2-19 Potable Water Sources.

**Table 2-7**
**MLWID Wells**

<table>
<thead>
<tr>
<th>Well Name</th>
<th>Description</th>
<th>Pumping Rate</th>
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<tbody>
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<td>Pigeon Wells 200’, 45’, and 19</td>
<td>Horizontal Wells</td>
<td>5 to 20 GPM</td>
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<td>Spring Catchment</td>
<td>4 to 8 GPM</td>
</tr>
<tr>
<td>Cold Spring</td>
<td>Spring Catchment</td>
<td>2 to 8 GPM</td>
</tr>
<tr>
<td>Carter Canyon Spring</td>
<td>Spring Catchment</td>
<td>5 to 10 GPM</td>
</tr>
<tr>
<td>Upper Sabino</td>
<td>Spring Catchment</td>
<td>5 to 35 GPM</td>
</tr>
<tr>
<td>Sabino Canyon Parkway</td>
<td>Vertical Well</td>
<td>5 to 10 GPM</td>
</tr>
</tbody>
</table>

Water Rights - Erin Boyle, Assistant Forest Planner for the Coronado National Forest, provided the Project Team with her University of Arizona draft master’s thesis report describing surface water sources and water rights for the Mount Lemmon area (Boyle, 2007). This report is included as Appendix H. Details regarding water rights for Mount Lemmon, including rights for the USFS and MLWID can be found in Appendix I.

**2.4.2 EXISTING WATER SYSTEM AND INFRASTRUCTURE**
MLWID stores water in above ground coated steel and galvanized steel tanks. The total current system storage is approximately 1,205,000 gallons. MLWID plans to add an additional 800,000-gallon storage tank in the near future which will bring the storage capacity to 2,005,000 gallons (Stanly, 2007). This tank may be used for buffering pH to improve the water quality in the system and reduce leaching of metals from galvanized components (see discussion below).
The existing storage for the service areas is provided by the following storage tanks:

<table>
<thead>
<tr>
<th>STORAGE TANK</th>
<th>GALLONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOMA LINDA</td>
<td>283,000</td>
</tr>
<tr>
<td>UPPER LOMA LINDA</td>
<td>60,000</td>
</tr>
<tr>
<td>CARTER CANYON</td>
<td>140,000</td>
</tr>
<tr>
<td>UPPER SABINO</td>
<td>212,000</td>
</tr>
<tr>
<td>SATELLITE</td>
<td>10,000</td>
</tr>
<tr>
<td>MINERS RIDGE</td>
<td>500,000</td>
</tr>
<tr>
<td>GUTHERIE</td>
<td>ABANDONED</td>
</tr>
<tr>
<td>FUTURE</td>
<td>800,000</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>2,005,000</strong></td>
</tr>
</tbody>
</table>

The district operates two separate sources to supply domestic water to the community. The Carter Canyon source water (POE#1) is captured and stored in the 140,000-gallon storage tank and is gravity fed to the community. The Upper Sabino Source water (POE#2) is captured in the 212,000-gallon storage tank and pumped to the 500,000-gallon Miners Ridge storage tank. The water is then supplied by gravity to the community. This system has a 250 psi in the village. A minimum of 175 psi is required to transfer water from this point to the Loma Linda storage tanks.

The existing service lines and main pipe materials in MLWID’s system consist of mainly copper and galvanized pipes with some Polyvinyl Chloride (PVC) and Ductile Iron Pipe (DIP). There are eight different sized mains throughout the entire system ranging from 1-inch to 8-inch diameter pipes with ¾-inch service lines. MLWID has 20 to 22 fire hydrants served by 6-inch DIP mains. Exhibit 2 illustrates the location of wells, storage tanks and distribution mains.
A proposed 800,000 gallon tank will be built in the Upper Sabino area. When fully operational, MLWID plans to treat the contained water in this storage tank with soda ash (sodium carbonate) to raise pH levels. The Carter Canyon System is also a gravity feed system with pressures ranging from 20 to 125 psi. All of the water is chlorinated with calcium hypochlorite tablets to a residual of 0.4 to 0.5 parts per million (PPM) at the storage tanks.

The water sources in the MLWID service area are the Upper Sabino and Carter Canyon Watersheds. MLWID at one time had 425 connections, but due to the fires, they now have only 275 connections (Stanly, 2007). The 2005 ADWR report shows that 4,385,600 gallons of water were pumped, where 4,205,600 gallons were delivered to customers, and 180,000 gallons were unaccounted losses. The graph below illustrates the water usage from 2001 to 2005. In the year 2002 there are no records due to the Aspen Fire. MLWID currently reports a total of 275 connections and has plans for total of 800 connections (Stanly, 2007). Flow rates for this system prior to the fires ranged from 20,000 gpd to 25,000 gpd. Current flow rates are 10,000 gpd. Usage is shown in Figure 2-20 (Appendix H).

![MLWID Water Usage Graph](image-url)
2.4.3 EXISTING WATER QUALITY (MLWID)

Many of the records for the MLWID were lost in the fires. Some data was obtained through the Water Quality Division, Drinking Water Section of the Arizona Department of Environmental Quality (ADEQ), MLWID personnel report the occurrence of elevated levels of copper and zinc in the drinking water supply. Although detailed studies have not been performed to confirm the cause, these elevated metal concentrations are thought to occur due to low pH of the Upper Sabino source water and ambient water quality, galvanized storage tanks, aging galvanized pipe lines on the distribution system. The pH of the Carter source has been observed to be 7.2 (2006) and Upper Sabino to be 6.4 (1996). Low pH is probably due to the influence of rain water which absorbs carbon dioxide (CO₂) from the air. This acidic water can cause corrosion, and mobilization of metals, in the metal pipes.

Additional source sampling may be needed to assess all the causes of elevated concentrations observed in influent to the WWTF. A discussion related to zinc and copper in the MLWID potable water supply are provided below and a discussion regarding copper and zinc mining near Summerhaven is also presented in this section.

Copper can be found in many kinds of foods, in drinking water and in the air. We absorb minute quantities of copper each day by eating, drinking and breathing. People that live in houses that have copper plumbing can be exposed to higher levels of copper, because copper is released into their drinking water through corrosion of pipes. In addition, copper may occur in solution in the oxidation states Cu²⁺ and Cu¹⁺ (Hem, 1992). Copper may be dissolved from water pipes and plumbing fixtures, particularly where water pH is lower, typically below 7 (Hem, 1992). Drinking water is tested by MLWID every three years; copper was detected at a concentration of 0.12 mg/L in 2000 in the MLWID potable supply. Post-fire data is not available. Primary drinking water action levels and
secondary drinking water standards exist for copper; the primary Action Level is 1.3 mg/L and secondary MCL is 1.0 mg/L (USEPA, 2003).

It should be noted that copper mining has been performed in the Catalina Mountains due to the presence of porphyry type deposits. Past mining for this mineral further supports that copper occurs naturally in this area. A total of six mines were located within 2 miles of the north end of Summerhaven as part of the Oracle Ridge Mining group. These mines recovered copper and zinc in underground workings from an ore body that is not dissimilar to the ore body at the recently closed San Manual Mine, located north of the Catalina Mountains. Figure 2-21. Oracle Ridge Mining Complex shows the locations of these mines with respect to the study area. Given that the primary source of drinking water for the MLWID is springs issuing from hard rock formations that contain economically viable copper ore bodies, elevated concentrations of copper and zinc in spring water may be due to ambient conditions.
Figure 2-21

Location of Oracle Ridge Mining Complex
Mt. Lemmon Study

Legend
- Outfall locations
- Waste Water Treatment Facility
- Oracle Ridge Mining Complex

Mt. Lemmon Service Area Watershed Study & Wastewater Management Plan (Project No. 206145)
TABLE 2-9. MLWID ZINC CONCENTRATIONS

<table>
<thead>
<tr>
<th>YEAR</th>
<th>WATER SOURCE</th>
<th>HARDNESS</th>
<th>*ZINC CONCENTRATION (Mg/L)</th>
<th>MCL (Mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9/27/93</td>
<td>CARTER</td>
<td>138 MG/L</td>
<td>0.1539</td>
<td>5</td>
</tr>
<tr>
<td>9/26/96</td>
<td>CARTER</td>
<td>228 MG/L</td>
<td>0.2356</td>
<td>5</td>
</tr>
<tr>
<td>9/27/93</td>
<td>SABINO</td>
<td>73.2 MG/L</td>
<td>0.0898</td>
<td>5</td>
</tr>
<tr>
<td>9/26/96</td>
<td>SABINO</td>
<td>114 MG/L</td>
<td>0.1309</td>
<td>5</td>
</tr>
</tbody>
</table>

* Zinc concentrations in the table above were extrapolated using hardness data obtained from ADEQ and MLWID. Tables for calculating dissolved zinc concentrations based on hardness were used to derive these concentrations.

Zinc is a very common substance that occurs naturally. Many food particles contain minute zinc concentrations. Almost all drinking water also contain zinc, which may be higher when it is stored in metal tanks and/or when corrosion occurs in galvanized pipes. Zinc occurs naturally in the air, water, and soil and is the 23rd most abundant element in the earth’s crust. Zinc has a secondary drinking water standard of 5 mg/L. This is not an enforceable standard.

Mining in the region has included recovery of both copper and zinc from ore deposits. Appendix J contains a Bureau of Mines document for mining in the Santa Catalinas. Information relating to ore production for mines located north of Summerhaven is provided in the table below.
2.4.3.1 Potential MLWID Upgrades - Source Control for Copper and Zinc

To reduce copper and zinc concentrations associated with the current water system infrastructure and source water, the following alternatives may be considered in plan implementation:

- Replace copper and galvanized service lines with PVC or DIP lines
- Existing steel storage tanks should be regularly inspected to ensure that the tank coatings are maintained
- Cathodic protection may be used to help prevent corrosion of the piping systems and storage tanks
- MLWID could treat the water with chemical inhibitors such as phosphates to mitigate corrosion of pipes and storage tanks.

However, given the presence of large faults in the area and that the geologic formations in which springs supplying drinking water are found, it is entirely possible that copper and zinc are naturally occurring and elevated in the local spring water and groundwater moving through open fractures. If the source control steps above are not implemented or do not reduce copper and zinc

<table>
<thead>
<tr>
<th>Mineralized Area (Deposit Type) Production Years</th>
<th>Ore (st)</th>
<th>Gold (oz)</th>
<th>Silver (oz)</th>
<th>Copper (lb)</th>
<th>Lead (lb)</th>
<th>Zinc (lb)</th>
<th>Tungsten (stu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marble Peak area (skarn) 1905-1993</td>
<td>849,500</td>
<td>4,550</td>
<td>580,500</td>
<td>38,837,000</td>
<td>81,000</td>
<td>37,000</td>
<td>NR</td>
</tr>
<tr>
<td>Korn Kob Mine area (skarn) 1913-1942</td>
<td>100</td>
<td>NR</td>
<td>150</td>
<td>12,000</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Oracle area (vein, replacement) 1881-1964</td>
<td>20,666</td>
<td>9,800</td>
<td>33,000</td>
<td>16,000</td>
<td>125,000</td>
<td>NR</td>
<td>&gt;21,020</td>
</tr>
<tr>
<td>Burney claims (vein, replacement) 1931-1967</td>
<td>4,500</td>
<td>NR</td>
<td>6,000</td>
<td>81,000</td>
<td>85,000</td>
<td>80,000</td>
<td>NR</td>
</tr>
<tr>
<td>Total</td>
<td>874,766</td>
<td>14,350</td>
<td>619,650</td>
<td>38,946,000</td>
<td>291,000</td>
<td>117,000</td>
<td>&gt;21,020</td>
</tr>
</tbody>
</table>
concentrations in the drinking water, then advanced treatment technology will be needed at the WWTF as part of upgrades prior to discharge to Sabino Creek - to ensure that discharge quality can meet Sabino Creek standards. If PCWMD petitions ADEQ and PAG to remove restrictions prohibiting discharge of treated effluent to the creek, then EEC recommends planning for WWTF improvements include treatment systems to remove lower concentrations of copper and zinc, in case source control measures are not successful. Costs for these systems are explored under treatment technologies, in Section 5.2.

2.4.4 USFS WATER RESOURCES IN THE UPPER SABINO WATERSHED

The USFS have no accurate records for yearly water usage but estimate the amount to range from zero to 3 million gallons a year (MGPY) (Hensel, 2006). A draft master's thesis report entitled Development of the Upper Santa Catalina Mountain Water Resource Management Plan, June 17, 2007 prepared by Ms. Erin Boyle, USFS Assistant Planner (Appendix H) shows that the USFS has rights to 35.49 acre-feet per year combined between surface water rights and well pumping/groundwater rights.

According to (Boyle, 2007), the USFS has a storage capacity of 2.15 AF (approximately 700,000 gallons) during the summer and 1.92 AF (approximately 625,000 gallons) during the winter on the Santa Catalina Mountains. Some USFS storage tanks are drained during winter months to prevent damage from freezing, explaining the seasonal change in storage. In addition, a booster station containing a 15,000 gallon (0.046 AF) surge tank is used. This system is supplied by source water from Dead Fir Spring west of the booster station and a 100’ vertical well located at the booster station. Both are in the Upper Sabino Watershed above the MLWID sources.

Future projections, as identified in Boyle (2007), are significantly lower than those of the MLWID. The USFS has no plans for the development of additional recreational or administrative facilities within the Mt. Lemmon area.
2.4.5 HISTORICAL AND CURRENT WATER DEMANDS

Permanent settlement began on Mt. Lemmon in 1882 as part of a mining claim. USFS water rights were recorded for the region as early as 1902. The present community of Summerhaven was established in 1917, according to Peters and Bales, 2001). The USFS and MLWID have been operating independent water supply systems since 1944 (Boyle, 2007).

Details regarding historical and current water demands of the two systems are presented in the draft master’s thesis which is included as Appendix H. Assumptions made in the report regarding pre and post fire usage rates contain some uncertainties, given the limits of sources of information. It should also be noted that future trends may not follow historical trends. This is discussed further below.

2.4.6 BASIS OF FUTURE WATER DEMANDS

The community of Summerhaven is in the planning stages for rebuilding and redevelopment after the Aspen Fire. Population projections maintained by PAG and other sources may not accurately reflect redevelopment efforts and should not be the source of decision making. Out of 878 lots in Summerhaven (including east and west area and the Sewage Planning Area defined in Section 8.3 of this report), there are estimated to be between 600 to 700 buildable lots in Summerhaven.

A new community center opened in July 2007, and a lodge with a design plan for 26 condominium units has been proposed. In addition, three restaurant lots are planned for rebuilding within the district. The trends in redevelopment are towards larger homes, condominiums, and resort type development as vacation destinations.

In the past, the area consisted mainly of cabins used for weekends and vacation. Trends in redevelopment are towards larger homes that may be occupied on a year round basis, though this has not been clearly established. While 100 gpd
usage was the norm for pre-fire connections to the water system, applications for Type 4 general permits suggest that redevelopment may include higher water usage and demand. Average daily flows reported in data provided by Pima County DEQ indicate that homes constructed after the fires have on-site wastewater system capable of treating average daily flows ranging from 300 to 750 gpd. That could be a greater than a 300% increase in water usage – if the design information used as the basis of permitting is an accurate prediction of actual water usage. There are uncertainties associated with the limited pool of data from which conclusions are being drawn. Therefore it is important that future data gathering address the uncertainties so that this plan can be calibrated as needed against the growing pool of data.

The assumed future annual potable water demand to build out was linearly projected to the Year 2027 based on the data summarized in Section 2.4.8, and adapted from Boyle (2007). As indicated in Figure 2-23, annual potable water demand is estimated to increase more than three times from Year 2007 to Year 2027. Projected future potable water usage for MLWID, as discussed in Section 2.4.8, is approximately 33.75 AF/Yr, and MLWID has a legal right to a total of 35.08 AF/Yr of water within the watershed. Therefore, MLWID has enough water rights to legally meet the annual projected water demand through the estimated build out projection, assuming that future growth follows patterns of past growth.
While the water is legally available to MLWID, on an annual basis, as discussed in this report, history has shown that physical availability of water may be limited during the high-demand months of April through June. During these months, seasonal potable water demand is high, evapo-transpiration is high, and precipitation is low. Impacts to water supplies during this time may result in decreased spring flows and reduction of base flow to Sabino Creek. It is possible that additional water storage tanks, replenished during the winter months and utilized during the early to middle summer months, may lessen the impact on the seasonal water supply availability. However, based on the information reviewed for this study, it is uncertain if water withdrawals at a rate of the legally permissible annual volume based on rights are sustainable without causing significant undesirable impacts to portions of the watershed.

Aquifer storage is the water balance component that becomes most important during times of drought and the determination of the sustainable use of
groundwater is not only a scientific determination, but also a complex one of socioeconomic and environmental concerns which can be difficult to quantify (Anderson and Woosley, 2005). The “safe yield” or the volume of water available for consumption is an oversimplification of the information needed to understand the effects of developing a groundwater water supply system. Conversely, “sustainable yield” will assume the acceptable consequences of altering the water balance of the watershed.

The water budget as defined by Peters and Bales (2001) is an estimate and based on limited data, and thus, not detailed-enough to determine the sustainable yield for the watershed. Specifically, data should be collected to determine the undefined potential impacts to base flow (groundwater contribution to stream flow) and spring discharge in the form of the following:

- Groundwater monitoring at selective monitoring points throughout the watershed;
- Aquifer testing to understand aquifer characteristics
- Frequent monitoring of spring discharge; and
- Gauging to determine baseflow in Sabino Creek.

Until data are collected and evaluated to understand the aquifer and current impacts to the hydrologic system, reliable estimates of the sustainable water availability can not be established. To estimate the sustainable supply of the Summerhaven water resources, the evaluation should include the needs not only of the potable water demand, but instream flows and riparian demands, as well.

**Resources, Water Supply and Water Budget**

The hydrology of the area is discussed further in the next section of this report. In general when discussing water supply for Summerhaven and its impact to potential wastewater flow and vice versa, it is important to take note of the geologic and hydrogeologic setting. The presence of impermeable bedrock in outcrop and at the ground surface suggests that groundwater is primarily present
in fractures in bedrock. Many of the fractures in the study area are filled dikes (pegmatites) which are would not be expected to have high permeability or be transmissive. Springs that do exist may be emitting from a limited fracture system, the extent of which and degree of interconnectedness is unknown and has been not been studied. A thorough hydrologic study and water resource investigation is needed to assess the availability of groundwater resources as a source of potable water supply and aquifer characteristics and to obtain data needed for decision making and assessing impacts to the system.

Given the presence of impermeable bedrock, it is possible that only limited resources are available and may be directly related to infiltration of precipitation moving through joints and fractures in hardrock. During a sustained drought resources are already limited and recharge to the local aquifer may be greatly reduced. The limited availability of water for recharge during a drought should be carefully considered in evaluation of options for reusing treated effluent for beneficial uses.

A limited hydrologic assessment of the available water in the Upper Sabino Creek basin was conducted by Peters and Bales (2001) using data from 1951 to 1999. The study attempted to quantify a monthly water budget for the watershed assessing: precipitation, snowfall, snowmelt, runoff, human use, evapotranspiration, stream flow, and groundwater. The processes of precipitation and evapotranspiration dominate the hydrologic water balance of the Upper Sabino Creek watershed (Peters and Bales, 2001).

They summarize the water balance as the following:

- Precipitation and evaporation account for approximately 56 percent of the water entering or leaving the basin on a monthly basis;
- Groundwater recharge and soil moisture storage account for approximately 19 percent;
- Stream flow is a minor component, contributing about 9 percent of the monthly flux;
Snowfall and snowmelt account for an estimated 9 percent of the watershed flux, each; and
Remaining processes account for less than one percent of the monthly flux in the basin.

At the end of the report the authors concluded that insufficient data was available to perform a true watershed balance.

Available Surface Water Rights in the Watershed
Water resources within the Mt. Lemmon region have been allocated through legal application by the Arizona Department of Water Resources (ADWR) based on prior appropriation doctrine. The Summerhaven community is located within the Tucson Active Management Area (AMA) and is regulated by the Groundwater Management Code; as a result, groundwater water right issues apply to groundwater at Mount Lemmon in addition to surface water rights. This means that recharge credits may be obtained for recharge of treated effluent, but due to current available geologic information, it appears that recharge is not a viable option; a detailed discussion related to this topic is presented in Section 3.0.

Erin Boyle, Assistant Forest Planner for the USFS Coronado National Forest, provided the Project Team with a draft of her University of Arizona master’s thesis summarizing surface water rights (including groundwater to be found in direct contact with surface water) for the Mount Lemmon area (see Appendix H) (Boyle, 2007).

Surface Water rights in the Mt. Lemmon area are held primarily by the MLWID and the USFS, according to information provided by Boyle (2007). A total of 70.55 acre-feet per year (AF/Yr) are on file with the State of Arizona for the region. Of that total, MLWID and USFS water rights are 35.08 AF/Yr and 35.49 AF/Yr, respectively. Of the MLWID water rights (35.08 AF/Yr) approximately 23
percent of the rights are for active groundwater sources. Less than five percent of the water rights held by the USFS in the region are for groundwater sources.

**Impacts on Water Yields**

The Upper Sabino Creek Watershed has not undergone the adjudication process; therefore water usage and the verified application of water rights is not strictly enforced within the watershed. Based on this fact, there is a great potential for water users to impact one another. Until enforcement becomes a priority, the risk of user impact exists.

As indicated above, the majority of potable water supplies currently utilized in the Mt. Lemmon area are from surface water resources (i.e. springs and creeks). In addition, the watershed, and thus surface water, is highly susceptible to the amount of precipitation occurring on a seasonal basis. Shallow groundwater, withdrawn from alluvium, or fractured bedrock, appears to have a direct connection to Sabino Creek and associated springs, thus a there is a potential for groundwater withdrawal to impact surface water levels (Peters and Bales, 2001).

As indicated earlier, groundwater withdrawal consists of the USFS and MLWID but also on domestic users.

**Recommendations for Water Rights and Conservation**

The draft masters thesis report entitled Development of the Upper Santa Catalina Mountain Water Resource Management Plan, dated June 17, 2007 Erin Boyle (Appendix H) provides details regarding surface water and groundwater rights, and should be referred to for details regarding both USFS water rights for the Coronado National Forest, and also MLWID water rights and demand issues. The draft thesis report provides basic water supply and water use data for pre- and post-Aspen Fire conditions, and predicts likely demand once Summerhaven cabins and commercial facilities are rebuilt. However, there are uncertainties and unknowns associated with future projections given the type of development
that is occurring and the limited data on which for form conclusions and recommendations.

Water users at Mount Lemmon are encouraged to work together to resolve the common water supply, water use, and wastewater management issues. Recommendations based on the draft thesis report are re-iterated below and have been augmented by this team:

Implication of the Instream Flow Right - a combined effort should be made to obtain instream rights for Sabino Creek. These rights will:

- Provide improved mechanisms and authority for protection of creek/watershed;
- Require monthly measurements to show flow amounts are being met for up to five years following preliminary approval from ADWR; and
- Lock watershed from future rights.

Data and Information Needs – The draft report recommends additional information be gathered. Recommendations made by Ms. Boyle can be found in her thesis and have been augmented below. Necessary data includes:

- Mapping of waters systems
- New Stream Gauge at Summerhaven to measure flow in Sabino Creek
- Local climatology station and data collection (precipitation, snowpack, evaporation)
- Water Quality Sampling as needed for plan implementation
- Groundwater resources in the area are not well understood. Mapping of fractures and springs in area and geologic mapping are recommended to assess occurrence of water in groundwater and issuing from springs to understand its origin and potential impact of development in close proximity to sensitive springs which serve as the primary source of drinking water;
• Distribution of information to the community regarding water conservation and outreach and educational efforts

Financial Needs and Options
• Funding for studies and information
• Obtaining grants given for collaborative efforts
• Work in cooperation with University to provide funding for information needs, graduate students and other interested parties with applicable expertise such as the USGS Water Resources Division.

Recommended Action Plan:
• Assess operation of water systems separately or as one
• Obtain a combined Instream flow right (USFS and MLWID)
• Increase storage capacity for both systems (USFS and MLWID)
• Take water conservation measures at Summerhaven such as implementing requirements for low flow toilets and fixtures for new homes
• Formulate policies as needed to protect sensitive drinking water sources in the area (springs)
• Assess impact of domestic water users with private wells

In addition to the recommendations listed above, EEC also recommends that PCWMD be involved in on-going planning efforts so that watershed management, water supply and water distribution are integrated for a unified approach to ensuring a sustainable future for Summerhaven.

2.4.8 WATER USAGE AND WASTEWATER PLANNING
Water usage and wastewater flows are connected but given the limited data set, the relationship at Summerhaven is not well understood as it relates to trends in redevelopment. While flows to the Mount Lemmon WWTF can be measured and
compared to projections as part of plan implementation, there is currently not a mechanism for comparing design flows for Type 4 general permit systems in Summerhaven against water usage and actual wastewater flows to see how home design and on-site wastewater treatment system design may provide meaningful data for future development trends and water and wastewater needs. Recommended steps for assessing the connection of water usage and flows include:

- Obtaining water usage data from MLWID on a regular basis
- Monitoring flows to the WWTF to compare actual flow to projected flow
- Establishing several test homes where water usage and flow to the on-site system are metered, measured and compared
2.5  Watershed Features (Surface Water)

2.5.1  Introduction

Purpose of Watershed Assessment
As part of this study, the existing watershed features in the Mount Lemmon community were assessed (covering portions of the Sabino Creek watershed San Pedro River watershed (location of the current spray field and outfalls), and Canyon del Oro watershed) including, but not limited to hydrogeology, stream flows, conservation priorities, and topographical contours. The assessment focused on the upper portions of these watersheds within the wastewater service area.

This assessment was performed to identify and assess watershed features that may affect the design and management of water supply and wastewater treatment systems within the service area. Available information sources were reviewed, a site visit of the upper watersheds performed, and then existing studies were summarized to form recommendations for any additional studies that may be needed. As part of this evaluation, available GIS coverages were reviewed, resulting in a recommendation that additional data is needed to delineate and characterize the affected watersheds, and provide the basis for subsequent environmental, hydrological, and infrastructure analysis and planning. This was a significant data gap identified. To move this plan forward into implementation, additional GIS coverage is recommended and studies performed as needed to support redevelopment and regulatory requirements.

Scope of Watershed Assessment
This watershed assessment is limited in scope and is a first-level survey based on available information. Based on the scope of work, this assessment did not include field studies or collection of new data. Relatively few literature and primary data sources were available for this initial assessment. One site visit was made to the Upper Sabino Creek watershed at Mount Lemmon and
Summerhaven on December 5, 2006. A limited set of GIS coverage was available for this initial assessment: it is anticipated that additional spatial data will be needed and used for subsequent implementation of this plan. The assessment focused primarily on the hydrology aspects of the Upper Watersheds: other Project technical studies will cover the ecological, socioeconomic, legal, and policy issues related to WWTF development.

Based on discussions with PCWMD, the Project Team and input from local stakeholders, the primary watershed of concern was identified as the Upper Sabino Creek watershed which includes the current wastewater service area and Summerhaven (tributary to the Santa Cruz River Watershed/Basin), extending from the slopes of Mount Lemmon to just below the Marshall Gulch picnic area, about 0.5 south of Summerhaven (Figure 2-23, Project Watershed). A small portion of the Upper Alder Creek watershed (San Pedro River Basin) that contains the treated effluent spray fields was also examined. These two areas served as the basis for the watershed assessment reported herein.
2.5.2 METHODS USED IN WATERSHED ASSESSMENT

Delineation of Project Watershed

Although the existing service area for the WWTF was defined at the start of the Project, additional information was needed to delineate the watershed or watersheds encompassing, and impacted by, the study area. Initial review of topographic maps showed that most of the study area was bounded by the ridge lines forming the Upper Sabino Creek watershed. The lower boundary of the watershed was determined at a point downstream from Summerhaven and the WWTF. The small spray field watershed was determined as the 10-acre area draining the hillslopes containing the spray field which leads to unnamed washes which are tributary to Alder Canyon/Alder Wash and the San Pedro River.

The Mount Lemmon Observatory facility on the top of Mount Lemmon was not included in the Project Area. This decision was made because the facility is outside the existing WWTF service area, utilizes a separate spring water supply, and is not within the Upper Sabino Creek Watershed. It should be noted that there is a contributing watershed to Sabino Creek located towards the east and also below Summerhaven. These do not directly impact the WWTF or options within the wastewater management service area and therefore were not considered further.

The Upper Sabino Creek and spray field watersheds were first delineated manually on a topographic map of the area, then by computer using USGS 10-meter Digital Elevation Model (DEM) data. ArcHydro, an application within ArcGIS, was used to automatically generate the watershed boundaries based on the DEM and stream coverage, and a selected starting point on the respective streams. The GIS generated watershed boundaries closely matched the hand-drawn boundaries and so the GIS generated polygons were accepted as accurate. Figure 2-24 and 2-25, Project Watershed Land Cover show the boundaries of the study area Watershed, including Upper Sabino Creek and the
spray field hill slope. Based on this first level delineation, the calculated area of the Upper Sabino Creek watershed is 1108.52 acres and that of the spray field site is 12.34 acres. These surface areas are needed to assess runoff potential resulting from a storm event, and is also needed to assess impact of possible stormwater flow from upper slopes into WWTF manholes as inflow and infiltration (I&I). Since the majority of the drinking water supply is thought to come from infiltration of rainfall, the size of the watershed also drives the volume of water falling in the water shed that may be captured by radial wells and springs, or in the absence of rainfall, may be dry.

**Review of Available Literature**

Review of available past reports, studies, internet sites, maps, and other materials related to the study area were performed. Only limited information was available, therefore none of these materials provided a comprehensive, up-to-date source of information required to fully assess the Watershed characteristics.

**Review of Available Geospatial Data**

Geospatial data were obtained to assess pre and post fire watershed attributes. Basic GIS coverages were acquired and used in the watershed assessment. Figure 2-27A GIS Data Layer Matrix (at end of text) lists the data layers that were gathered and the agencies and private sources that were contacted as part of this study. This information may be needed as part of site screening and site selection for development of beneficial use options that are identified in Section 3.0 of this report and for analyzing and displaying future data gathered as a result of recommendations presented in the report. Information obtained was used to form the figures presented in this section and to accurately define the watershed and study area boundary for areas that may influence the WWTF. A DVD of geospatial data, viewable in ArcMap Version 9.2 is included in this report as Appendix K.
2.5.3 WATERSHED FEATURES

Geography and Land Use

The project area is located in the Santa Catalina Mountains north of Tucson, Arizona. Mount Lemmon is the highest peak in the range and its eastern slopes comprise the headwaters of Sabino Creek. The community of Summerhaven is situated within the Upper Sabino Creek watershed and encompasses various private in-holdings within the Coronado National Forest (USFS 1988) in addition to limited private land.

As part of an EIS performed for the current WWTF, Finical & Dobrowski (1977) provided a description of the project area that remains current today:

Summerhaven is located near the top of the Santa Catalina Mountains in an area of extremely rugged terrain which is characterized by mountain tops and ridges, separated by canyons and gulches. The Catalinas are located northeast of Tucson, adjacent to the Tucson Basin. Elevations of the Catalina Mountains range from 6,000 feet to 9,000 feet with Summerhaven situated in the Catalinas at approximately 7,600 feet in the bottom of a canyon. Sabino Creek enters Summerhaven at the north end of town and runs south through the community, paralleling Sabino Canyon Park Road. Dirt side roads, some of which are extremely steep and can be traveled only by jeep, provide access to the homes and cabins along the canyon sides.

As the stream flows south through the community and down through Marshall Gulch picnic ground, it slopes southward at a rate of 300 feet per mile...[Any] development in the study area is topographically limited. Approximately 18% of the 200 acre community of Summerhaven is unsuitable for development if for no reason than the high cost of construction on slopes in excess of 40 [degrees] in this remote mountainous area. Most of the land development has occurred on the flatter parcels along the creek and up some of the slopes of the canyon. The cabins and commercial establishments are built on two to three feet of alluvium which is situated on bedrock. The canyon which Summerhaven is located in varies in elevation from 7,600 feet at the bottom to 8,300 feet at the top of the ridges. The canyon walls are subdivided by various drainages which terminate in Sabino Creek.
Figure 2-21 (previously shown) Project Watershed Hydrology shows the mountainous, mostly forested terrain in which the Project Watershed is situated. This aerial image was downloaded from the Terra Server internet site (image dated October 16, 2002) and has a horizontal resolution of 0.3 meters. This image shows the damage to forest cover on the spray field watershed caused by the 2002 Bullock Fire; however, it does not show the more damaging impacts caused by the 2003 Aspen Fire, which burned much of the Upper Sabino Creek and adjacent watersheds. Post-2003 aerial imagery is depicted in Figure 2-25, Project Watershed Landcover 2006, showing the extent of fire damage and subsequent recover.

**Climate**

The climate of the study area is characterized by cool summers and cold winters. Summer daytime highs are in the mid-70s and low 80s and overnight lows are in the 40s and low 50s. Low temperatures in the winter are commonly in the 20s with occasional lows in the single digits (WRCC, 2006). Climatic data, particularly temperature extremes and snowfall depth, is an important consideration for the design engineers who are analyzing various facility alternatives and beneficial options for reclaimed water. Table 2-3 below provides monthly highs and lows.
Table 2-3. Record and Average High and Low Temperatures for Mt. Lemmon, Arizona (WRCC 2006)

<table>
<thead>
<tr>
<th>Month</th>
<th>Record Low °F</th>
<th>Record High °F</th>
<th>Average High</th>
<th>Average Low</th>
</tr>
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<tbody>
<tr>
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<td>-4</td>
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<td>49.2</td>
<td>22.8</td>
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<tr>
<td>February</td>
<td>-7</td>
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<tr>
<td>May</td>
<td>27</td>
<td>82</td>
<td>69.1</td>
<td>36.6</td>
</tr>
<tr>
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<td>76.4</td>
<td>44.4</td>
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<td>July</td>
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<td>August</td>
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<td>82</td>
<td>73.6</td>
<td>49.8</td>
</tr>
<tr>
<td>September</td>
<td>31</td>
<td>81</td>
<td>70.4</td>
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</tr>
<tr>
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<td>20</td>
<td>76</td>
<td>61.7</td>
<td>36.4</td>
</tr>
<tr>
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<td>4</td>
<td>71</td>
<td>56.3</td>
<td>29.7</td>
</tr>
<tr>
<td>December</td>
<td>4</td>
<td>65</td>
<td>50.6</td>
<td>24.3</td>
</tr>
</tbody>
</table>

Mt. Lemmon receives approximately 29 inches of precipitation annually, with nearly half of the total occurring during the monsoon (early July into September). On average, over seven inches of rain falls during the month of August (WRCC 2006). The monsoon is characterized by frequent afternoon and evening thunderstorms, some of which can become severe and drop several inches of rain in just a few hours. Rainfall totals surpassing 4.5 inches in a 24-hour period have been recorded (WRCC 2006). Frequent lightning also accompanies most storms. Monthly precipitation is presented below in Figures 2-26 and 27.
Due to the limited extent of the data in the graph above and recent drought conditions, EEC obtained additional precipitation data for the vicinity of Mount Lemmon. This is presented in Figure 2-29 and extends from 2000-2006.
Snow is common during the winter months as is shown in Figure 2-28 (WRCC 2006). The summit of Mt. Lemmon receives approximately 180 inches of snowfall annually (Finical and Dobrowski 1977). Record snowfalls of a foot or more have occurred on several days throughout the winter months. However, the southern latitude of the area results in extremely variable winter weather both during the winter season and from year to year. In some years very little snow falls, resulting in a light or even non-existent snowpack. Snow depths typically range from 5 to nearly 25 inches during the winter months. Record depths between 45 and 75 inches have been recorded. The light snowpack makes options such use of reclaimed water/treated effluent for options as snowmaking desirable to some stakeholders. The feasibility of this as an option is explored later in this report.

Limited precipitation in the area is relevant to the water supply that is available at Mount Lemmon for re-development efforts. Sustained drought makes water resources both limited and valuable in the study area. These factors are important when evaluating options for long term management of wastewater.

Figure 2-28. Average and record snowfall amounts on Mt. Lemmon

The contrast between the hot, dry climate of the Tucson basin and the relatively
mild, moist climate on Mount Lemmon is what has attracted people to build seasonal and year-round homes in Summerhaven. Finical & Dobrowski (1977) described the climate as:

...typical of high altitude Rocky Mountain climatic regions, characterized by cool summers and cold winters. Summertime highs in the mid 70’s and lows in the 40’s are common. Temperatures during the winter months may drop as low as 25 [degrees]. The overall average temperature during December is well below freezing. The study area receives about 28 [inches] of precipitation during the year, the majority of which falls during the summer months of July, August, and September, and during the winter months of December through March. Snow is common as low as 5,000 feet, and slopes at 7,500 to 9,000 foot elevations will retain snow for considerable periods of time. Some 85 inches of annual snowfall may be expected in the Summerhaven area, increasing linearly with elevation to 140 inches at the ski lift.

The Mount Lemmon Nonpoint Water Pollution Abatement Plan (PAG 1978) indicated a somewhat higher annual rainfall in the project area: “Climate within the study area is typical of the high, desert mountains. Annual rainfall varies from 30-35 inches with winter temperatures frequently below 20 deg Fahrenheit. The combination of unique scenic qualities has made the Sabino Creek Watershed a valuable recreation resource.”

The amount of rainfall and snowmelt in the Mount Lemmon area is typically sufficient to recharge the soil profile and local aquifers which are thought to be of limited areal extent, and sustain year-round flow from springs to streams in the upper reaches of the Sabino Creek watershed. However, evapotranspiration losses of water from the watershed depend on the density of tree cover which has historically varied depending on land management and wildfire history. The Mount Lemmon Wildland-Urban Interface Plan for Forest Health and Wildland Fire Management (Mount Lemmon Fire District, 2004) observed that:

Historically the ponderosa pine forest of the Santa Catalina Mountains was more open as evidenced by the photograph of the Huntsman Cabin taken before 1915. The openness was probably due, at least partially, to frequent low intensity fires. Disturbance to the vegetation for roads, home
site clearing, fire protection and hazard tree removal has occurred over the most accessible areas.

Recent climate data for the Mount Lemmon area can be found on the Western Regional Climate Center website (http://www.wrcc.dri.edu/index.html). The table below provides a summary of monthly temperatures and precipitation for Palisade Ranger Station (elevation 7950 feet), approximately 5 miles away from and about 200 feet lower than the study area Project Watershed. For the 30 year period 1971-2000, average annual precipitation is 32.24 inches, bi-modally distributed between winter and summer months. Average rainfall is lowest during the late spring and early summer (prior to the summer convective storms), a period of high water demand by plants and residents and visitors of the Summerhaven community.

### PALISADE RANGER STN, ARIZONA (026202) 1971-2000 Monthly Climate Summary

<table>
<thead>
<tr>
<th>Jan</th>
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<th>Mar</th>
<th>Apr</th>
<th>May</th>
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<th>Jul</th>
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<td>32.24</td>
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</tbody>
</table>

Source: Western Regional Climate Center (http://www.wrcc.dri.edu/index.html)

### Geomorphology, Geology, and Soils

Sabino Creek drains a 35.5 square mile watershed (PAG 1978) and extends about 15 miles from its source on Mount Lemmon to its confluence with Tanque Verde Creek (PAG 2002a). The Upper Sabino Creek watershed drains less than 1.7 square miles and extends about 2 miles from Mount Lemmon to a point below Marshall Gulch picnic area. The treated effluent spray field is about 10 acres in area. The Project Watershed in this study is nearly identical to that used by Finical & Dobrowski (1977).

Information on the geology and soils of the Summerhaven-Mount Lemmon area has been summarized in several previous reports. Finical & Dobrowski (1977) stated that Summerhaven is located on the Leatherwood Quartz Diorite of Pierce
rock unit. The rock types which make up this unit consist of gray quartz diorite and gneissic rocks. Marshall Gulch is situated on the Pioneer Formation which is characterized by rocks which are locally metamorphosed and schistose. The Mount Lemmon Ski Valley is situated on undifferentiated metamorphosed, schistose to gneissic sedimentary rocks. They reported that the soils in this area consist of Mirabel-Baldy-Rock Outcrop Association based on a report prepared by the US Forest Service (USFS). Outcrops in the area provide important information about groundwater resource availability.

Winneberger (1978) looked at the local geology in terms of wastewater management. He found that the geology of that area could be described as a matrix of granite, weathered to many feet deep, and containing many pegmatite dikes (filled fractures). The strike and dip of those dikes seemed to have no consistent pattern and although well fractured, the quartz and feldspar rocks were generally quite hard. He concluded that there would be no practical way to explore each individual lot to determine its suitability for an on-site septic tank system. Winneberger’s report contains soils analysis data and percolation test results.

Hennington (1981) conducted a planning study of Summerhaven Village for the US Forest Service. Hennington described the four soil mapping units in the planning area as including: Sancan very gravelly sandy loam - 25-50% slopes (coarse fragmented parent material and exposed bedrock); Sykes cobbly sandy loam - 25-50% slopes (bedrock fractured soil with cobble and stones as dominant features); Sykes cobbly sandy loam - 10-25% slopes (bedrock fractured soil with cobble and stones as dominant features); and Haploboralis and Eutroborealfs - 5-20% slopes (weathered parent material with a sandy loam surface). These soils all have an average depth of 8-18 inches to bedrock and have a medium to neutral pH. Hennington found that the Summerhaven planning area, and much of the Santa Catalina mountain range, falls within hydrologic soil groups D and C. Group C soils have moderate to slow rainfall
infiltration/ permeability rates and Group D soils have a very slow rate of infiltration when thoroughly wetted and have a moderately slow to very slow permeability rate. These soils exhibit inherently high runoff rates, although this is moderated by vegetation and soil cover. As a consequence, these soils also have a moderate to high erosion hazard rating.

**Hydrology**

The depth to bedrock beneath the facility varies from occurrence in outcrops to a depth to top of formation of 24 inches. It is unknown if bedrock conveys groundwater or not. Given the absence of deep water supply wells in Summerhaven, it is suspected that an inter-connected, open fracture system that yields water is not present. This is further supported by an extensive pegmatite dike system – where fractures visible in outcrop are filled with mineralization.

The shallow depth to bedrock affects disposal options for the facility (such as drip irrigation systems) and the types of technical requirements likely to be applied to achieve success in various permitting programs for specific options. The subject property is bisected by a small drainage/dry wash, the positioning of which may limit or affect development options. Drinking water in the area is supplied by springs, catchment basins and shallow horizontal wells that collect water for consumption. The presence of springs suggest that bedding planes and fractures conduct water along preferential pathways, which have not been assessed or studied to date to understand their origin.

Finical & Dobrowski (1977) described the hydrology of the project area as follows:

Scattered springs and surface water in Sabino Creek presently serve as the major source of water supply in the certification area of Summerhaven. The discharges from several of these springs, however, are too small to be economically developed and inadequate for long-term use. The major springs which are currently in use include Carter Spring, Pigeon Spring, Cold Spring, and Upper Sabino Spring. These surface water elements are
located upstream of the point of wastewater discharge and are tributary to Sabino Canyon Creek

...Along Sabino Creek there is a potentially high risk for flooding. The [pre-1982] treatment facility is located at the bottom of a narrow canyon only fifteen feet from the creek on alluvium which is approximately three feet above the creek bed. Minor flooding does exist in and along Sabino Creek during brief, intense showers. The impermeable slopes in the study area cannot absorb all of the rainfall; consequently forms of sheet flow or flash flooding do exist. During periods of flooding, the location of the [pre-1982 sewage plant] may be under water causing impacts on sensitive areas due to chemical and biological pollutants being washed into the creek.

Hennington (1981) observed that “Sabino Creek within and below the study area is considered to be a semi-perennial stream because it gives the appearance of being seasonal, but this is not always true. In dry years, and years where the water level drops significantly, the stream recedes into the soil where it runs underground. Fish, for this reason, are almost non-existent at and below the Summerhaven area.”

The Pima Association of Governments (PAG) inventoried surface and shallow groundwater bodies in developing GIS coverages for the Sonoran Desert Conservation Plan. They determined that Sabino Creek had “…perennial flow for most of its length and intermittent flow near the confluence with Tanque Verde Creek. The upper portion of Sabino Creek was fairly well documented as being perennial…” For the area near Summerhaven they found that:

Sabino Canyon at Summerhaven was determined to have shallow groundwater based primarily on the ADWR [Arizona Department of Water Resources] Well Registry. Although well coverage was sparse in this area, a few wells with shallow water levels were present near the canyon. Several springs were also located in or near the delineated area. This portion of Sabino Canyon was previously identified as having perennial stream flow. The area was drawn to be the narrow canyon bottom based on the USGS NED dataset and the PCLIS shapefile for topographic contours. The area was drawn to include the wells and springs that were nearest the creek. The extent of shallow groundwater was likely broader than the area delineated, but data were not available to confirm this.
Riparian vegetation existed in this area, according to the Harris vegetation coverage.

Shallow groundwater is likely occurring in quaternary alluvium (QAL) located above bedrock and the extent of the shallow groundwater determined by topography of the bedrock and drainages that are filled with alluvium.

Previously referenced Figure 2-23 Project Watershed Hydrology shows the location of key hydrology features within the Project Watershed. These GIS data sets include ephemeral and perennial streams (Arizona State Land Department, Arizona Land Resources Information System), springs (USGS), and ADWR-registered wells (GroundWater Site Inventory - GWSI). It does not indicate non-registered wells, minor springs, seeps, and impoundments.

The location of ADWR registered wells (Figure 2-23, Watershed Hydrology shown previously) should be considered in site screening and selection for potential reclaimed irrigation sites or outfall locations to make sure that separation requirements are met for water supply wells. Given the fracture flow environment and unknowns associated with location and extent of fracture systems, additional buffers should be given to make sure water supply wells and springs are protected by any discharge or disposal sites screened or selected.

The full extent and locations of seeps and springs have not been mapped and field mapping and new hydrologic data collection was not a part of this scope of work. Prior to site selection, the locations of seeps and springs should be identified and mapped. This data gap should be filled in the implementation process for this plan.

The location of springs which are tributary to Sabino Creek is important not only from a potential surface water right perspective, but also from protection of these springs with respect to Sabino Creek designated uses and surface water quality
standards (SWQS) which may apply to protecting the quality of these springs when developing sites for reclaimed irrigation or outfalls.

Additional hydrogeologic assessment is needed to implement this plan for any disposal options that include injection or recharge. Additional studies would also be needed to fully assess the availability of groundwater resources in a bedrock environment, including an exploratory boring and corehole program to assess the occurrence and connection of fractures in bedrock.

**Water Quality**

Toups Corporation (1977) conducted a non-point source analysis of the Mount Lemmon area for the PAG. They reviewed the Bickler and Patterson water quality sampling data for the Upper Sabino Creek and concluded that “…the sewage treatment plant with 44 services (point source discharge) has a much greater impact on the water quality of Sabino Creek than does the non-point discharge originating from 330 dwellings in the study area…” Finical & Dobrowski (1977) reported that a preliminary study in the 1970s “indicated that wastewater discharge has resulted in stream pollution due to inadequate treatment and occasional malfunctioning of the chlorination facility. Subsequent monitoring programs further revealed that bacterial contamination of the stream extends to the Marshall Gulch picnic area. Due to potential public health hazards, the picnic area was closed for public use in 1975.”

The Pima Association of Governments (PAG 1978) reviewed and summarized information on water pollution sources within Mount Lemmon area. Based on data available in the 1970s, among their conclusions was that:

- The quantity of pollutants due to horse and/or dogs on the watershed is enough to account for all the nonpoint pollutant outflow.

- Nonpoint pollutant sources which must be controlled to provide swimmable and fishable waters include 1) improperly operating human waste disposal systems, 2) litter, 3) animal enclosures, 4) free roaming dogs, 5) activities causing erosion and sedimentation into the stream.
• A continuing water quality monitoring program should be established to assure that the recommended program is achieving water quality goals.

• A record should be kept of results of water quality sampling along upper Sabino Creek down to gaging station

In the 208 Plan Point Source report for Mount Lemmon, the Pima Association of Governments (PAG 1981) noted several sub-watersheds located within the PAG portion of the Lower San Pedro River watershed, including some important perennial streams that provide aquatic and riparian habitat for native species. It was noted that there were no wastewater treatment facilities in this area. “However, the Mount Lemmon WWTF discharges effluent via spray irrigation in the Corona National Forest within the boundaries of the Lower San Pedro watershed. There are no other permitted point sources of pollutants.” The report did not indicate any downstream water quality problems associated with the wastewater treatment facility spray field.

The PAG (2002b) report on the Water Quality of Priority Streams in Pima County provided information on water quality and habitat in the upper and lower portions of Sabino Creek:

Sabino Canyon is a tributary of Tanque Verde Wash in the Santa Cruz River drainage. The creek was determined to have perennial flow for most of the upper portion. The stream flows through more than 800 acres of hydro-mesoriparian habitat, a deciduous riparian forest, and a mesquite bosque; it is associated with shallow groundwater. Historically, three native fish species and leopard frogs have been found here. This stream may be a possible Gila topminnow reintroduction site. Potential impacts to water quality could come from heavy recreational uses and the introduction of exotic aquatic species.

ADEQ [Arizona Department of Environmental Quality] sampled the water in Sabino Creek below Summerhaven for general water chemistry parameters. Recent monitoring of the reach above the east fork of the Sabino Canyon documented that a few isolated ponds had naturally occurring low dissolved oxygen. The reach from the headwaters to the Tanque Verde Creek was assessed by ADEQ and found to be in full support of its designated use.
Lower Sabino Canyon, in the Sabino Canyon Recreation Area, has intermittent stream flow to near the confluence with Tanque Verde Creek. A succession of large pools, which sustain populations of Gila chub, can be found year round in this reach. This reach is accessible through the recreation area and is used heavily for recreation. Use impacts to this stream could be recreation, erosion and sedimentation, and the possibility of the release of harmful substances into the water. Another problem for lower Sabino Canyon is the presence of nonnative aquatic species that have a negative impact on the native aquatic species.

The ADEQ's 2007 report on Surface Water Assessment Methods and Technical Support reported the most recent water quality assessment for sites on Sabino Creek. The report indicated that a segment of Sabino Creek above Tanque Verde Wash was attaining the designated use for fish consumption and agricultural irrigation, but was inconclusive for warmwater fishery, full body contact, and domestic water supply. The report also mentioned the impact of the 2003 Aspen Fire which burned 84,750 acres in the Coronado National Forest, including a major portion of Sabino Canyon’s watershed. The fire started on June 17, 2003. Samples collected on July 23, 2003 reflect the impact of this fire on water quality with exceedances of cyanide, lead, manganese, and selenium criteria. The old turbidity criterion (50 NTU) was also exceeded on July 23, 2003 at 2800 NTU. Subsequent monitoring on February 19, 2004 and September 13, 2005 contained only a lead exceedance. Available ADEQ water quality data for Sabino Creek is presented in Appendix E. ADEQ is still assessing post-fire water quality data, therefore data gathered by Dr. Lin Lawson immediately after the fires was not made available by ADEQ to this team though initially requested in May 2007 (Rebecca Sydnor of EEC, 2007).

**Post-Wildfire Watershed**

infrastructure for the city of Tucson. Within the community of Summerhaven, near the top of Mount Lemmon, about 300 structures were destroyed. The fire also burned a large portion of the Cañada del Oro watershed on National Forest lands above developed private lands.

The following emergency treatment objectives were identified:

- Stabilize the watershed and remove or stabilize potentially hazardous materials before the first damaging storm,
- Reduce risk of breach hydrology,
- Reduce risk of pollutant and contaminant transport,
- Reduce risk to downstream infrastructure and residences,
- Reduce risk to life and property,
- Maintain emergency access to critical communication sites, and
- Reduce loss of site productivity (when complementary to other objectives)

Treatment was highly successful in the Carter Canyon watershed, especially on north-facing slopes above the community of Summerhaven. Treatment was not as successful on the south-facing slope above Summerhaven. Treatment was highly successful farther up the watershed above the Forest Service boundary. Plants were well developed and 20 to 30 inches in height in many places. Effective ground cover was greater than 90% at observation points along both slopes just above the creek. Treatment was highly successful on Radio Ridge. Again, plants were 20 to 30 inches in height and effective ground cover was greater than 90% at observation points on the ridge and along the Aspen Trail below the ridge.

Treatment was very successful in the Marshall Gulch area. Most of the Marshall Gulch watershed was untreated, but the picnic area near the confluence with Sabino Creek, the east-facing slope along the road, and a small portion of the south-facing slope in Marshall Gulch received treatment. Treatment in the Sykes Knob picnic area was successful in the picnic areas, and very successful on west-facing slopes draining into Sabino Creek. The treated areas of upper Sabino Creek, Carter Canyon, and Bear Canyon were revisited. The removal of floatable material and vegetation from channels, and protection of culverts with
trash racks was effective in protecting road crossings and downstream infrastructure.

Pima County Public Works documented the impacts, costs, and recovery activities related to the 2003 Aspen Fire (PCPW 2004). The destruction of so many trees and forest vegetation greatly enhanced the danger of flooding and erosion putting Summerhaven and downstream areas at risk. The Flood Control District undertook substantial efforts to minimize these risks, working closely with the United States Forest Service, Natural Resource Conservation Service and other agencies. County agencies and groups developed new zoning code amendments, rezonings, comprehensive plan amendments, and the International Urban Wildland Interface Code to ensure proper post-disaster rebuilding and protect the community against future wildfires.

The catastrophic wildfires had significant impact on the response of the affected watersheds. Shaffer and Reed (2005) reported on the effects of the 2002 Bullock Fire and 2003 Aspen Fire on watersheds in the Santa Catalina Mountains. After the wildfires, runoff from the burned areas increased significantly. Rainfall amounts and intensities that normally would have caused little if any flooding had the potential to produce dangerous flash floods. For example, on August 7, 2003, 1.25 inches fell within an hour in the Sabino Creek near Mount Lemmon watershed, a 3.4 square mile watershed which was estimated to have experienced 30% high severity and 25% moderate severity burn. The former USGS stream gauge located on Sabino Creek near Mount Lemmon recorded 350 cfs. According to the NOAA Atlas 14 (2004), the rainfall had a frequency of a 2-year one-hour event. The resultant flash flood equated to approximately a 10-year pre-burn flood. This amounts to a burn area post-burn runoff three times greater than runoff during pre-burn conditions.
2.5.4 WATERSHED RECONNAISSANCE

Post-fire Watershed Observations

A one-day reconnaissance tour was conducted of the Upper Sabino Creek and the Spray Field watersheds. The results of the reconnaissance are provided below, based on observations.

Ski Valley – Mount Lemmon Peak: Figure 2-29 shows the northeastern slope of Mount Lemmon, the headwaters of Sabino Creek. This is part of the Ski Valley resort area. The area was only partially impacted by the 2003 Aspen Fire and retains a good vegetative cover. Figure 2-30 shows the communication towers on Radio Ridge west of the Summerhaven community. Like many sites on the watershed this ridge and surrounding hillslopes suffered severe damage in the Aspen fire.

Spray Field: Figures 2-31 and 2-32 show two views of the treated effluent spray field in the headwaters of Alder Creek (San Pedro Basin). The trees were killed by the 2002 Bullock fire but groundcover vegetation has returned and effectively protects the soil. The spray field pipe distribution system was reportedly destroyed in the fire and subsequently repaired, although the distribution system was not observed on this visit.

Summerhaven: Figure 2-33 illustrates the proximity of the built environment to Sabino Creek. The creek runs through the center of the community and is the receiving water body for runoff or groundwater from the development. In this photo, the road parallels the stream obscured by riparian vegetation. The damage caused by the Aspen Fire is depicted by the stands of dead trees on the hillslopes west of Sabino Creek (Figure 2-34). This photo demonstrates the new home building and infrastructure improvements taking place at Summerhaven.

The area just south of the Marshall Gulch picnic area, appears to be gently grading, perennial stream with a rather small baseflow discharge (Figure 2-35). The large borders, tree trunks, and debris piles strewn within the narrow channel...
attest to the watershed’s ability to generate much larger flows during storm runoff events. Further south from Marshall Gulch, the stream grade becomes steeper and the canyon opens up to a wide expanse (Figure 2-36). A former US Geological Survey (USGS) stream gage is located about 0.5 miles south of Marshall Gulch on Sabino Creek. This station was not visited. It has been reported that this gaging station is maintained now by another organization.
2.5.5 PUBLIC WORKSHOP

PCWMD and the Project Team held a public workshop in Tucson on 12 February 2007 to brief Summerhaven community stakeholders on the Project purpose and history, and to involve them in prioritizing and developing management options for the community wastewater system. The Project Team members in attendance included PCWMD, US Forest Service, EEC, SAGE, AMEC, and Gordley Design Group. Forty-two members of the public attended this workshop.
Group Interest Statements

After presentations by the Project Team, participants broke out into four groups: Recreation, Environmental, Residential, and Residential/Commercial. Each group discussed goals, opportunities and constraints, while a scribe recorded comments on flip charts.

Below are key issues identified and discussed by the groups that are related to watershed and water resources management within the project area:

Recreational

- Recharge treated effluent into groundwater to increase local groundwater (opportunity).
- Return treated effluent back in Sabino Creek to increase stream flow (opportunity).
- Retain water taken from Sabino Creek back to the creek to maintain natural flow regime (opportunity).

Environmental

- Use treated effluent to irrigate revegetated areas and create more green space (goal and opportunity).
- Use treated effluent to provide water for fire protection in built-up areas (opportunity).
- Look for ways to improve the entire watershed area/riparian zone (opportunity).
- Monitor the water quality of the effluent (opportunity and constraint).
- Strive for public-private cooperation for reclamation of spray and discharge (opportunity).
- Develop new uses for reclaimed water (opportunity).
- Conduct analysis of spray field in relation to burned soils (goal).
- Remove legal restraints to discharge treated effluent into Sabino Creek (goal and opportunity).
- Address water quality problems caused by wildlife and other natural sources (constraint).
• Address erosion caused by fire-damage to old homes and new construction (constraint).

• Analyze effect of fires on watershed areas (opportunity).

• Manage vegetation to enhance in-stream flow (opportunity).

• Determine if the treated effluent spray field is still effective post-Bullock Fire (goal).

• Keep water taken from the Sabino Creek watershed in the watershed (goal and opportunity).

• Consider other sites (specifically southwest side of school) for spray field.

**Residential**

• Install treated effluent storage tank on top of Mount Lemmon for use by ski area (opportunity).

• Spray the treated effluent back onto residential lots within Summerhaven (opportunity).

• Use treated effluent for landscaping to create a greener village (opportunity).

• Determine future site for spray field (goal).

• Address US Forest Service’s concern over additional discharge to current spray field (constraint).

• Determine if snowmaking is an option for the ski area (goal).

• Address problem of existing septic tanks discharging into the Sabino Creek watershed (constraint).

• Input treated effluent at upper end of Sabino Creek watershed (goal).

**Residential/Commercial**

• Address the limitations on development of a wastewater disposal system caused by variable soil conditions (constraints).

• Manage watershed for vegetation and trees (goal).

• Determine the availability of water supply (goal).

• Better manage and track water use within the community (goal).
• Minimize water use and wastewater generation within the community (goal)

Synopsis of Watershed - Water Resources Related Comments
In general, the meeting participants were in favor of improving the community wastewater treatment system, eliminating the problem of septic tanks, improving and enhancing watershed conditions by better water and vegetation management, returning treated effluent to the Sabino Creek watershed, and ensuring downstream water quality. The participants were also interested in exploring other practical uses of the treated wastewater to include irrigation of common areas, fire protection, and snow-making. There was no stated interest in extending the Project study area beyond the proposed Upper Sabino watershed and small portion of Alder Creek watershed where the spray field is located. Attendees did not express a need to include the Mount Lemmon observatory in study considerations.

2.5.6 RESULTS OF ASSESSMENT – KEY FINDINGS

Limitations of First Level Assessment
As indicated in Section 1.3, the scope of this initial watershed assessment for the Mount Lemmon Wastewater Management Plan was very limited. The available literature provided useful summaries of the history and development of the current wastewater facility, the local water sources, and water quality issues. However, no primary source data (e.g., soils surveys, water quality laboratory reports, hydrographic survey reports, well levels) were examined for this assessment, only secondary reports. The majority of information available for this assessment was 20 to 30 years old. Where appropriate this information was incorporated into this study. Recent studies and information were found to be very limited and data collection, mapping, and field work were not a part of this scope of work. Therefore, data gaps are identified in this section and other sections in the report that will need to be filled to implement this plan.
Major Data Gaps

One of the primary objectives of this study was to develop GIS coverages for the Project Watershed. This was to be done by extracting data from existing GIS coverages that included the Project Watershed, organizing and quality checking these coverages, and using them to develop new thematic coverages and to perform analysis. Although some key data sets have been acquired (e.g., Digital Elevation Model [DEM], streams, wells), sources of auxiliary data sets needed for a complete watershed assessment (e.g., detailed soils, land ownership, geology, fire damage, vegetation cover, post-2003 aerial imagery) have not yet been identified.

General Watershed Condition

From review of the literature and the site visit, it was evident that the Upper Sabino Creek watershed is typical of mountain watersheds in the desert Southwest: it receives sufficient rainfall to sustain forest-type cover but has insufficient catchment area and soil/groundwater storage to provide for consistent perennial flow, especially under current water use conditions. The water available for development is limited by the amount and timing of precipitation falling on about 1.7 acres of catchment area, and whatever might be exported from springs and stored groundwater in adjacent catchments.

The wildfires in 2002 and 2003 have greatly altered the vegetation cover and evapotranspiration losses from the watershed. However, it appears that the erosion control and revegetation measures taken after the fire have prevented large-scale damage to the soil resource (so far). The destruction of residential and commercial infrastructure at Summerhaven has presented an opportunity for the community to develop new strategies and systems for managing their limited water supply and to ensure that wastewater disposal does not contribute to water quality problems downstream.
**Conservation Priorities**

The stakeholder agencies, businesses, and citizens who participated in the workshop have made known their conservation priorities for the Project Watershed, in regards to water and wastewater management. These would include:

- Return treated effluent to the Upper Sabino Creek watershed, either to enhance stream flow or to use as a non-potable water supply (for irrigation, toilets, firefighting, snowmaking, etc.).
- Allow more hookups to the wastewater system to reduce the need for septic systems.
- Prevent any degradation to water quality in Sabino Creek.
- Provide for seasonal storage of water to maintain sufficient supply during summer season.
- Increase and protect instream water rights.
- Manage forest cover to increase and sustain perennial streamflow.

Wildfires will continue to pose a hazard to human life, property, and environmental resources on Mount Lemmon, and will likely become more frequent if drought conditions persist or the climate turns drier. The adoption of new zoning regulations and the International Urban Wildland Interface Code will require some changes to private land management including vegetation modification in the built-up area. The US Forest Service is currently revising the Coronado National Forest Forest Land and Resource Management Plan which will outline their conservation priorities for the Project Watershed.

### 2.5.7 CONCLUSIONS AND RECOMMENDATIONS

**Geospatial Data Gaps for Plan Implementation**

The primary objective of Subtask 2.5 was to characterize the watershed features of the Project Watershed. A basic characterization was completed which identifies boundaries of the upper watershed and topography. The characteristics of the watershed were assessed with respect to climate,
precipitation and hydrology. Essential data sets were acquired and GIS used to delineate the watershed boundaries and depict watershed features as required by the scope of work.

- Coordinate watershed assessment and data sets with other elements of implementation and design effort (e.g., environmental, engineering) and integrate watershed information into the master study report.

- Identify and acquire spatial data sets needed for final analysis and design and to support implementation-related activities such as site screening and development under special use permits or private agreements.

- As part of this study and ensuing sections, assess the need for additional watershed assessment, analysis, and data collection as part of site selection for various options identified in this report.
3.0 Regulatory Issues

Background
Location - The Pima County Mt. Lemmon Wastewater Treatment Facility (WWTF) is located at 12633 North Sabino Canyon Park Road on land owned by Pima County in the community of Summerhaven. As shown previously in this report, the property is located on the west side of Sabino Creek (Figure 2-2). Summerhaven is bounded on all sides by Coronado National Forest which is managed by the Department of Agriculture, United States Forest Service (USFS). This means that all land use options for expansion and disposal necessitate one of the following and related permits as needed to support the uses:

- access and use of USFS land by special use permit;
- acquisition of private land,
- or agreements with private land owners through a political agency, management district, right of way, easement, or other legal process.

WWTF Start of Operations - The WWTF was constructed in 1982, prior to the Aquifer Protection Permit (APP) program, and at the time was regulated by both the Arizona Department of Health Services (ADHS), Division of Environmental Health Services (EHS) and the USEPA. The WWTF is considered an “Existing Facility” under the Aquifer Protection Permit Program as defined by Arizona Revised Statutes ARS 49-201(16).

The WWTF operates under a Type 1.09 General APP, an USFS special use permit for a spray field located in the Coronado National Forest, an AZPDES permit for discharge to 3 outfalls, and the Certified Area-wide Water Quality management Plan (208 Plan). All of these have limits that affect operation, plant capacity, average daily flow, peak flow, disposal options, and plant modification.
<table>
<thead>
<tr>
<th>Permit/Program</th>
<th>Expiration Date</th>
<th>Flow Limits</th>
<th>Renewal/ Replacement Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>APP General Permit</td>
<td>Rule Conditions no longer satisfied</td>
<td>20,000 gpd</td>
<td>~18 months</td>
</tr>
<tr>
<td>AZPDES</td>
<td>~Dec 2011</td>
<td>12,500 gpd Mo. Ave, 17,000 gpd Daily Peak</td>
<td>~ 18 months</td>
</tr>
<tr>
<td>USFS Special Use</td>
<td>June 1, 2022</td>
<td>12,500 gpd Mo. Ave, 17,000 gpd Daily Peak</td>
<td>NEPA – up to 2 yrs</td>
</tr>
<tr>
<td>PAG 208 Plan</td>
<td>NA</td>
<td>18,189 gpd (1981) and no Discharge to Sabino Creek</td>
<td>~9-18 mos</td>
</tr>
</tbody>
</table>

Treatment and Disposal - The current WWTF is located inside a building, that provides noise and odor control. The current WWTF is rated for a capacity of 15,000 GPD. Treatment processes at the Mt. Lemmon WWTF consist of a circular oxidation tank aeration basin with chlorination and dechlorination providing secondary treatment of domestic sewage. Sludge is transported offsite and is deposited into the County collection system at Manhole 8716-03 (see Figure 3-1, Manhole Location) for subsequent treatment at the Ina Road WWTF and solids conditioning and processing at the Regional Biosolids Facility.

As stated earlier in this report, treated effluent from the WWTF is disposed of in a spray field that is located on United States Forest Service (USFS) land located northeast of Summerhaven. The disposal field is located in a different surface water basin and watershed than the WWTF. Water supplied to the town of Summerhaven from the Santa Cruz and Rillito watershed is disposed in the form of treated effluent to the spray field or outfalls to unnamed washes which lead to Alder Wash, tributary to the San Pedro River.
Mount Lemmon Sludge Disposal Site
Manhole 8716-03

Figure 3-1 Manhole Location for Sludge Disposal
Feasibility of Options for Wastewater Management

To facilitate discussion and decision making, EEC compiled a matrix of options for the Mt. Lemmon WWTF and evaluated those options, including disposal and reclaimed options and probable regulatory, cost, and special design impacts.

The matrix is included in this report as **3-2 Matrix of Wastewater Management Options (end of text)** and provides a one page depiction of whether various options will result in regulation under fewer or more regulatory programs and result in increased costs and/or permitting or regulatory approval timelines compared to other options. Three options for the WWTF flow and treatment were considered: no WWTF Upgrade, major modification (either upgrade or expansion and replacement) of the WWTF at the current location (without treatment capacity and with increase in treatment capacity); and construction of a new WWTF at a new location. These options were cross compared to regulatory impacts and key considerations including: land needs; Aquifer Protection Permitting (APP) requirements; Reuse requirements; AZDPES requirements; Hydrologic Studies and Law Changes; Special Design Requirements; USFS and NEPA requirements; Other Permits or Regulatory Program requirements that might apply; conveyance system needs; growth projections and impact on flow; community relations; and, cost.

Three primary options were assessed in this report and in the Matrix of Wastewater Management Options for WWTF flow and treatment:

- No WWTF upgrade
- Upgrade or Expansion (replacement) of the Current WWTF
- New WWTF at a new location
No WWTF Upgrade/Flow Equalization
This option assumed that peak flows could be addressed with possible installation of off-site flow equalization systems on private land to address peak flows during weekends and holidays, and increase of flows up to the USFS special use permit and the APP Type 1.09 General Permit limitations. This option could carry the WWTF for up to a 3 to 5-year period, assuming that growth projections presented in Section 7 of this report are accurate and growth continues to follow predictable patterns. This option allows time for PCWMD to obtain permits that have longer permitting timelines, but is not a realistic option for long term growth projections. This option has been combined with options below in recommendations by EEC to PCWMD. While this option is the lowest cost it will only address short term flow rates.

Interim Upgrade and Long-term Expansion of the WWTF at the Current Site
This option assumed that 25 to 50 foot setbacks could be achieved without waivers from adjacent property owners for set backs, and that full noise and odor controls are installed in an expansion of the current WWTF. Cost assessment assumed that PCWMD is not responsible for collection lines of 8-inch diameter or less and the existing trunk line does not require upgrade to accommodate increased flows. This option assumes that up a 50,000 gpd WWTF can be fit on the current site and meet setback requirements for full noise and odor controls. Costs were compiled and reviewed for a plant of up to 50,000 gpd capacity. EEC assumed that either a new plant or upgrades to the current WWTF would be constructed to achieve new facility BADCT treatment performance standards in A.A.C. R18-9-B204(B) and any additional requirements for reclaimed use that may apply (such as filtration to upgrade BADCT treatment performance standard discharge quality to A+ classification).

The modification or expansion of the current WWTF will require an individual APP (if over 20,000 gpd) or may be regulated by a general APP (if less than 20,000 gpd). An individual permit will be needed if reclaimed use is selected as
the disposal option, since the reclaimed classification needs to be listed in the individual APP. The timeline to obtain a non-expedited APP is approximately 18 months, assuming that the application is complete upon submittal and PCWMD is responsive to ADEQ requests. Two options were carried forward into recommendations: interim upgrade through plant replacement in 2011 to improve effluent quality to meet reclaimed use classification requirements with the current WWTF capacity remaining unchanged (adding treatment units to the current WWTF as needed to achieve discharge quality objectives); and expansion of capacity to 50,000 gpd in before 2022 to meet future growth projections. As an option for interim upgrade and long term plant expansion, EEC has included advanced treatment to remove copper and zinc in case these elevated concentrations cannot be reduced through source control. This option also results in the need to amend the USFS Special Use Permit (SUP) and if the plant is expanded, also the AZPDES permit.

It should be noted that engineering and land development issues associated with upgrading in 2011 and then expanding in 2022 were factored into recommendations. If the current WWTF is upgraded by addition of treatment units to the existing plant, it is possible that a replacement package plant for expansion will not fit side by side with the upgraded plant as would be needed to transition during expansion. Therefore, EEC also assessed if it is economical and practical to perform full expansion before 2011 and operate the expanded WWTF at low flows. The findings of this are presented in Section 5.0 and the recommendation is for replacement of the current plant in order to provide efficient treatment (especially with respect to influent nitrogen levels) and provide a margin of error for flow projections, given the trend towards significantly larger homes in the area that may be designed for year round occupancy. Costs associated with upgrading the WWTF through plant replacement used in the decision matrix were $3.4M plus advanced treatment costs of $20,000.00. Costs of upgrading through additional treatment units were estimated to be
approximately $1.1M, but this option would not provide efficient treatment given influent concentrations.

Building a New WWTF at a New Location
This option assumed that due to size restrictions of the current site, a new location is selected for building a new WWTF and evaluates the potential regulatory impact of selecting a new site. While it does not seem that another location would be needed based on preliminary assessment by EEC engineers, regulatory and other impacts for this option were assessed in case the option is considered at some point in time. Plant costs used as the basis for the last column of the matrix were based on a new 50,000 gpd WWTF and the upper end of construction of the WWTF was estimated to be $6.2 million, excluding costs associated with property acquisition. This assumes that plant meets new facility BADCT treatment performance standards in A.A.C. R18-9-B204(B) and does not include costs associated with any additional requirements for reclaimed use that may apply (such as filtration to upgrade BADCT treatment performance standard discharge quality to A+ classification or additional treatment to reduce zinc and copper concentrations to meet SWQSs). The timeline to obtain a non-expedited APP is approximately 18 months, assuming that the application is complete upon submittal and PCWMD is responsive to ADEQ requests.

Disposal Options
Disposal options determine which additional permits and regulatory program requirements may apply and drive whether special design requirements may be needed. The disposal options considered in the matrix were:

- Continued use or expanded use of the current spray field and AZPDES outfalls in the San Pedro Watershed;
- total reclaimed use for reforestation using native trees such as aspen and white fir that have limited but some uptake water in the winter and other reclaimed uses such as use of water for fire-fighting;
• recharge of treated effluent in recharge wells to obtain Arizona Department of Water Resource (ADWR) credits; and,
• discharge to a new outfall in Sabino Creek (assuming the prohibition in rule can be revised).

Use of the Current Spray Field – the benefit of this option is that a special use permit is still in place for monthly average flows up to 12,500 gpd, a new piping system would not be needed to convey the effluent from the plant site to the spray field and costs associated with construction of the expanded spray field are likely to be low. However, the regulatory impacts of this option may have challenges to the project timeline and other project objectives which are discussed further in Section 3.1. These pertain to the NEPA process and timelines which may extend up to 2 years if there is not a Finding of No Significant Impact (FONSI) at the EA stage or if a Categorical Exclusion does not apply.

At the time a new or expanded WWTF comes on line with increased flows, a new or amended special use permit needs to already be in place to allow discharge to start for the increased flows and revised plant operations or to new areas. Issues associated with this option are discussed under Section 3.1 below. The growth curve presented in Section 7 of this report indicates that in as few as 3 years additional disposal capacity may be needed as flows may exceed the limits in the USFS special use permit. This means that an amended special use permit would need to be ready and other permits associated with the expanded WWTF in place in 3 years or less to accommodate the flows.

Total Reclaimed Use of Treated Effluent - The various regulatory program impacts on the WWTF and disposal options are discussed later in this section. In general, if total reclaimed use can be put in place and consumptive use demonstrated using standard models such as Blainey-Criddle, then application/irrigation areas will be considered non-discharging under both APP and AZPDES programs even during winter months. In this scenario an AZPDES
permit would not be required, assuming the irrigation area is properly designed to prevent ponding and runoff. If sufficient irrigated acreage can be obtained for the rate of uptake by either aspen or white fir (or another equivalent native tree or plant that takes up water in winter freezing conditions), then models can be used to successfully show that reclaimed water will be taken up by the irrigated areas. If irrigation is performed at true consumptive use rates, this is a demonstration that there is no reasonable probability of discharged effluent reaching Sabino Creek (in the event that the prohibition of discharge is not successfully lifted through a request for rule revision). In this scenario, neither an AZPDES nor APP permit is required for the irrigation area, only for the WWTF. APP requirements relating to reclaimed classification and reclaimed quality monitoring would be put in the individual APP for the WWTF. A reclaimed permit (or permits) would still be required, but the timeline for obtaining reuse permits is relatively short (6 months generally) compared to other permitting options. Preliminary assessment suggests that the engineering viability and economic viability of this total reclaimed use is worth exploring. Depending on what land is used for this option – private or National Forest – the NEPA process may or may not be involved. Performing reclaimed irrigation with consumptive use on private land will not require a NEPA process.

Use of reclaimed water for winter snowmaking was put into the matrix as an option. In order to use water for snowmaking reclaimed use, it must be treated to A reclaimed standards in accordance with A.A.C. R18-11-309, Table A. Without lifting the prohibition of discharge to Sabino Creek, realistic consideration of use of reclaimed water for winter snowmaking is likely to rely on two hydrologic studies that may have substantial cost. Given that the ski area is located in the watershed to Sabino Creek, springs are present in the area, and shallow fractured bedrock is present, a thorough hydrologic study is needed to show there is no hydrologic connection between the application area at the ski slopes and the creek. While this hydrologic study could include gathering of existing geologic and hydrologic data, exploratory borings, wells and cross sections are
probably needed at key locations to assess depth to bedrock, fracturing and the possibility of hydrologic connection with the creek (or to simultaneously pursue lifting the prohibition on discharge to Sabino Creek). It should be noted that the MLWID water supply comes from shallow horizontal wells that are in the vicinity of the ski area. Therefore studies regarding use of reclaimed water for snowmaking would need to assess potential for impact of snowmelt on surface water runoff and water collection systems.

Even if the demonstration is successful and it can be shown that there this activity will not result in runoff from the snowpack or inadvertent discharge to Sabino Creek from subsurface hydrologic connection, there can be negative public perception associated with use of reclaimed effluent for snowmaking that would need to be overcome. Given the extent of human contact, even though consumption is not likely, the public to date has not embraced this option. Proposals for this at Snowbowl in Flagstaff have not been successful, have been costly, and have been blocked by significant public response. A large faction of response for use of reclaimed water at Snowbowl came from tribal nation reaction to use of sacred lands at San Francisco Peaks for disposal of wastewater. This reaction occurred in spite of studies which indicated that a large part of the artificial snow created from reclaimed water would be lost to evaporation. It is important to note that the USFS has already been contacted by Tribal Nations expressing concern over rumors regarding potential use of reclaimed water for snowmaking at Ski Valley.

Hydrologic studies to assess evaporation and snowpack would be needed in support of this option at Mount Lemmon to show that runoff will not occur from application areas, especially since the ski area at Mt. Lemmon is located within the Coronado National Forest and the community water supply comes from shallow subsurface collection systems. NEPA requirements will apply for this use of reclaimed effluent on National Forest land. NEPA will involve tribal consultations, and possibly cultural resource surveys and State Historical
Preservation Office (SHPO) interactions. This increases project exposure and may result in adverse response from the community. This possibility should be weighed heavily in evaluating this as a realistic option for disposal of wastewater from the Mt. Lemmon WWTF.

Given numerous issues associated with this option, although it was considered it was not carried forward as a recommended option.

Recharge of Treated Effluent – the quality of the effluent for an expanded plant will be required to meet new facility BADCT treatment performance standards. Therefore the quality of the effluent proposed for recharge should meet numeric AWQS for all constituents at the end of pipe. A detailed hydrologic study would be required for a recharge/injection project, including exploratory borings to establish subsurface properties and determine appropriate recharge well design.

The downside of this option is that it requires two additional permits to be obtained: an ADWR recharge permit in addition to the aquifer protection permit, and USEPA underground injection control (UIC) permit. Depending on the quality of effluent or potential USEPA concerns for other water bodies, the pathway for obtaining approval for injection could be complicated and take up to 2 years. It is also important to note that due to limited land availability, the adjacent Pima County parcel may be the only option for location of recharge wells.

Given that bedrock is shallow beneath the ground surface, vadose zone treatment would not be offered by the subsurface prior to treated effluent reaching fractures in bedrock and it is unlikely that the underlying gneiss and granite will receive injected/recharged wastewater – to even assess this would require an extensive and expensive study to find open fractures. Demonstration of compliance with discharge standards would be required at the point of discharge. Hydrologic studies associated with this option may be substantial to prove that there is no communication or day-lighting of treated effluent through
hydrologic connection to the nearby Sabino Creek, which is located approximately 200 feet from the WWTF site or possibility of impact to the local water supply system. ADEQ and possibly EPA will require compliance with discharge standards at the point of injection. If EPA requires an individual UIC permit, the injection point would be identified as a point of compliance. However, since the hydrologic system is not well understood and there are wells located within ¼ mile of the WWTP which may be used for domestic water supply, it is possible that in addition to end of pipe standards, if groundwater is found to be present in fractures, groundwater monitoring wells will be required by ADEQ to demonstrate compliance with Aquifer Water Quality Standards (AWQS) in the uppermost aquifer beneath the facility and to address hydraulic connection concerns. In a hydrologic setting where groundwater flow is driven by fracture patterns, alluvium in drainages, and bedrock outcrop, numerous wells may be needed for permitting and cumbersome and costly monitoring requirements are likely. Given the perception of potential hydraulic connection between shallow groundwater and Sabino Creek and concerns relating to day-lighting of treated effluent, to pursue this option EEC would recommend that the County simultaneously pursue lifting the prohibition on discharge to Sabino Creek. However, EEC does not recommend that recharge or injection be carried forward as a feasible option given uncertainties in success and the high cost of hydrologic studies which would be necessary to even assess whether this option would work.

Discharge to New Outfall in Sabino Creek – in order for this option to be feasible Pima County would need to pursue a rule revision to lift the prohibition in A.A.C. R18-11-123(A). PCWMD can petition ADEQ for this rule revision, but the next opportunity for triennial review of the SWQS rules is in 2010. This means that if successful, the revised rule might not be in place until 2011 or 2012, depending on the timeline of the rule making process, which has the potential to take more than one year once a docket is opened. In general the community appears to support this option based on community meetings held to date. Although there
are endangered species living in Sabino Creek, interactions with Federal agencies suggest that a year round baseflow from the WWTF may have a positive effect on the environment for these species, assisting in their survival and growth, rather than a deleterious effect.

This option would require both APP and AZPDES permits, and given that Sabino Canyon is located in Coronado National Forest, the USFS has stated that NEPA requirements will also come into play.

This option includes public involvement and exposure during two public comment periods for the APP and AZPDES permits and, if triggered, also multiple public input opportunities during the NEPA process. While public involvement is important, if the project is not embraced, these processes may also affect project outcome and the project timeline. If pursuing this option, given the possible response during the rule making process and public comment periods, in order to meet growth projections and flow projections which suggest capacity will need to be expanded as soon as 2012 to meet peak flow needs. Therefore, pursuit of a parallel disposal option(s) is be recommended. This is also suggested in case either PAG or ADEQ to not embrace the concept of renewed discharge to Sabino Creek, even with improved discharge quality from interim upgrade.

As a part of assessing the feasibility of this option, EEC compiled effluent data for the Mt. Lemmon WWTF and computed SWQS for Sabino Creek using the effluent data and data from samples of Sabino Creek that were collected in December of 2006 and March of 2007. This exercise indicated that the current WWTF is not producing effluent quality that would meet current SWQS that would apply for Sabino Creek and additional treatment would be needed for this discharge option to be feasible, unless the creek is classified through rule revision as an effluent dependent water (EDW). In assessing the standards, EEC used December 2006 and March 2007 ph, temperature and hardness data from samples collected in Sabino Creek to calculate SWQS. Although after discharge of treated effluent to the creek ADEQ may consider the creek an
effluent dependent water (EDW), to be conservative EEC calculated the standards as using receiving body characteristics (as a non-effluent dependent water) and then assessed performance of the current WWTF in comparison to the standards. Based on limited review, current effluent quality appears to exceed current SWQS for Sabino Creek for the following constituents: total residual chlorine; ammonia; nitrate; nitrite; nitrate-nitrite; copper; total cyanide; zinc; bisphthalate; chloroform; and, total trihalomethanes. For success in lifting the prohibition and meeting standards, an upgraded WWTF capable of producing effluent that meets BADCT treatment performance standard discharge quality would be needed. Further it is possible that either additional treatment or reduction of sources of copper and zinc in influent may be needed for success with this option, given the elevated concentrations of these two metals in current WWTF influent.

Between the timelines required for rule revision and permit issuance and construction of an upgraded WWTF with the current capacity or expanded WWTF with increased capacity, it is important to note that discharge to Sabino Creek is not a realistic option to address peak flows that may result from projected growth that is expected to occur in the 3 to 5 year timeframe. But this is a feasible option for longer term planning, based on the growth projections presented in Section 7 of this report and the schedule which was developed based on the parallel pathway development chart presented in this section.

**Land Needs, Availability and Terrain**

The community of Summerhaven is surrounded by Coronado National Forest which is Federal land. The limited availability of private land for acquisition impacts disposal options for the WWTF. Because the adjacent land is Federally owned, use of it not only requires special use permitting, but also results in National Environmental Policy Act (NEPA) requirements applying to requests for special use. NEPA is discussed in greater detail later in this section of the report.
The area surrounding the Mt. Lemmon WWTF is steeply sloped. Topographic relief in the area affects both on and off site disposal options. The amount of flat land available for development is very limited. Much of the land is forested, even if trees were burned in fires, therefore cleared, flat areas are very limited. Therefore the feasibility of options such as construction of a surface impoundment for wastewater storage or reclaimed storage is low. Short-term storage would be more realistically performed in storage tanks which are exempt from the APP requirements, rather than constructed impoundments. Impoundments would need special efficient design to fit in limited available space and also to meet APP BADCT requirements for liner systems and freeboard.

The steepness of the terrain means that reclaimed options may require landscape architecture design and properly installed subsurface irrigation drip lines in the root zone and if possible below the frost zone to ensure that reclaimed water does not runoff, and adaptations to run warm water through lines to open them during freezing conditions. Freezing conditions and steep terrain mean that subsurface irrigation application methods are the most appropriate for this locale. There may be a very limited amount of private land suitable for development for forest irrigation. Even if private land owners welcomed use of reclaimed water to grow trees on their property, a delivery/conveyance system would be needed to get the reclaimed water to the property. This means that this is probably only realistic as an option within a small radius of either the WWTF or of a storage area, if a storage tank site is developed uphill and off-site.

The steep terrain also directly impacts the costs of collection, conveyance and distribution, whether associated with collection of the sewage from homes or a possible wastewater improvement district collection system, or a distribution system for application of reclaimed water for reforestation.

Depth to Bedrock – information in the project files suggests that bedrock (gneiss and granite) outcrops at the ground surface or is less than 24 inches from the ground surface in the immediate vicinity of the current WWTF. The presence of
shallow and possibly fractured bedrock affects the feasibility of disposal options and also the type and extent of hydrologic study necessary to support options.

Community Relations – public involvement is a component of all options identified and some options have more intensive public involvement components than others (such as the NEPA process for use of National Forest). This means that public relations efforts are a vital element in achieving success for each option, especially each disposal option. Continually taking the pulse of the community and soliciting feedback and input early on in identifying options and selecting options will be an important objective. Some of the options such as snowmaking or continued use of National Forest present greater opportunities for delay and objections by stakeholders and will require involvement of experts in this area, and public meetings.

Some options such as reforestation may be embraced more by the community and may be perceived as beneficial by a community that is recovering from two devastating fires. Steps such as offering up reclaimed water in storage tanks for fire fighting may be welcomed by the community and are worth consideration in planning and development. These considerations were all a part of carrying forward recommended options through the matrix used to evaluate options.

3.1 USFS Special Use Permit, NEPA and Impact on Option Feasibility

A special-use authorization is a legal document such as a permit, term permit, lease, or easement, which allows use, rights or privileges on Forest Service land (USFS n.d.). The authorization is granted for a specific use of the land for a specific period of time whether long term or temporary. All requests must be consistent with laws, regulations, orders, policies of the USFS, and all applicable state and local laws. Furthermore the permit must be made consistent with standards and guidelines in the applicable Forest Land and Resource Management Plan (USFS n.d.).
The current WWTF discharges to a spray field located in the Coronado National Forest Federal land with the permission of the USFS under Special Use Permit SAN0139, dated February 18, 2003 and amended through Amendment 1 dated December 1, 2004. The permit is for use of a 10-acre area.

Watershed Transfer - The Special Use permit states that a USFS objective is to minimize removal of water from the Sabino Creek watershed and disposal of the resulting wastewater on National Forest land in the San Pedro Watershed. Expansion of the irrigated area is contrary to an objective stated in the USFS special use permit. This suggests that a EA may be required for a proposed expansion of the spray field and if this option is proposed to USFS, evaluation of other alternatives will be required as part of NEPA process, including alternatives that will result in discharge of treated effluent back to the Sabino Creek watershed.

Federal NEPA Process - The National Environmental Policy Act was created to ensure that all Federal Agencies’ policies, plans and programs would be undertaken with careful consideration of their impacts on the environment. The Act, and guidelines set forth by the Council on Environmental Quality make it mandatory that an environmental impact statement (EIS) be written whenever there is a significant potential of adverse impact upon the environment as a result of EPA action.

There are three aspects of the NEPA process. All require a level of scoping of the proposed action as a first step. The depth of scoping depends on the significance of the project. If initial scoping identifies no issues, a Categorical Exclusion and decision Memo can be completed in a matter of weeks. If scoping identifies issues, alternatives are developed to address the affected environment and environmental effects. At this point, if the issues are determined not to be significant, an Environmental Assessment (EA) may be completed. This may take 6 to 9 months, assuming supporting data is in hand at the start of the process (archeological, biological, etc.). If the issues are determined to be
significant, an Environmental Impact Statement (EIS) is needed. This process may take up to two years. All three levels provide opportunities for public involvement. The EA and EIS processes are performed by contractors rather than the USFS personnel and may cost $500,000.00 or more.

Special Use Permit Amendment and USFS Objectives - The special use permit was amended in 2004 to accommodate 30 additional connections, as long as monthly average flows do not exceed 12,500 gpd and the maximum of 17,000 gallons in one day. The special use permit allows for up to a total of 77 possible connections that are authorized by the permit and other related documents referenced by the permit. The total flow allowed by the special use permit was not increased in Amendment 1, even though additional connections were added. This may be a re-affirmation of the USFS objective stated in the current special use permit regarding discharge of the effluent within the same watershed of origin.

Expiration Date and Renewal - The current USFS special use permit expires on June 1, 2022. Provided there are no changes to plant operations or increase in flow beyond the 12,500 gpd monthly daily average, the special use permit does not require modification.

To renew the special use permit without modifications to the facility, the permit holder sends a written request for renewal to the local Forest Service office. If the renewal is for continuation of the same use and there are no issues, the Forest Service reviews the request and if there are no objections the District Ranger signs off for renewal, returns the request to the applicant and then the District Ranger approves the renewal. Any changes to the use of the land or permit conditions must be documented in the request for renewal. If the WWTF is not expanded and the same disposal method remains in place, the renewal process would be initiated in late 2021, prior to expiration of the current permit. If operations change or the use of the Forest Service land changes, the NEPA
process may be initiated at the time of renewal or with changes made beforehand.

Amendment of the Permit - If flow of effluent to the spray field from an expanded or new WWTF increases discharge rates above the limits in the current special use permit, an amendment of the special use permit would be required. An amendment of the special use permit will also be required if operations change substantially through facility upgrades or through expansion/major facility modification or plant replacement, even if the process change results in improved effluent quality. Since growth projections suggest that peak flows may exceed the limit in the special use permit in the future, and the NEPA process can take 2 years assuming baseline data is in hand at the start of the process, if PCWMD expands the WWTF to accommodate increased flows and additional flow will be directed to the spray field, then the amendment for facility expansion and spray field expansion should be initiated in time to ensure that the amendment is in place prior to increases or operation of an upgraded or amended facility.

If the WWTF is upgraded without increasing flows to the spray field, an amendment to the USFS Special Use Permit will be required. However, if the upgrade is improving water quality and not changing flow characteristics, this amendment can be done through a letter approval process which takes several weeks.

If more significant changes are made, such as added disposal options, then either an EA or EIS will be likely requirements.

In giving consideration to the NEPA process and impact to the timeline, it is important to note that an interdisciplinary team will be formed as a part of this process and other agencies will be consulted during the EA and EIS processes. While the process will be lead by EPA and the petitioning party, other issues such as cultural resource consultations may become a part of the process, bringing new views to the table. Each step involving public involvement could
result in project timeline delays and redirection if community relations issues are not identified at the start of the process, and considered in the formulation of each alternative and then utilized in performing impact analysis.

NEPA requirements will also apply for discharge to Sabino Creek since Sabino Canyon is located in the Coronado National Forest and the downstream recreation area is managed by the USFS and the Pusch Ridge Wilderness area is located immediately south of Summerhaven. This means that initial steps in the NEPA process such as gathering baseline data and scoping may be started at the same time the County is pursuing the rule changes needed for lifting the prohibition on discharge to the creek. This will allow the project to move forward in NEPA as soon as the SWQS rule prohibition is revised to allow discharge of treated effluent to Sabino Creek. Baseline studies needed to show no significant impact to support an EIS should be initiated in the next year so that data can be collected and used in the NEPA process after the SWQS rule is revised.

Assessing Options in the Regulatory Setting
The Matrix of Wastewater Management Options, Figure 3-2 explores various disposal options for the WWTF effluent. Figure ES-4, Mt. Lemmon Parallel Development Pathways is provided as a part of the recommendations and illustrates the strategy for treatment and multiple disposal and beneficial uses as part of this plan. It is possible that some options such as installation of a storage tank to supply water for firefighting, which would be of benefit to the community and USFS, will qualify for a NEPA Categorical Exclusion for use of Coronado National Forest — assuming that private land use options are not identified. If private land use options exist and cost is the only reason that these are not desirable, then the USFS will not issue a Categorical Exclusion or special use permit. Therefore a necessary part of moving forward with developing a storage tank site north of Summerhaven would need a site screening and selection step. In order to use USFS land for this tank location, it must be shown that the tank
can only be sited on USFS because of access issues by helicopters, land slope restrictions, and engineering considerations such as gravity head, etc.

Other options under consideration – discharge to Sabino Creek and use of USFS for reclaimed irrigation to grow native trees may result in the need for an EA or EIS (for Sabino Creek and EIS is likely). This is true if threatened and endangered (T&E) species may be affected by the disposal or reclaimed use option. Examples of impact that would require assessment is clearing large areas of land that may constitute habitat to T&E species and would require study prior to development.

Options such as snowmaking would involve application of wastewater to large areas of land and aside from cost considerations associated with conveyance, would require a minimum of an EA and possibly and EIS.

### 3.2 Aquifer Protection Permit Program & Impact on Option Feasibility

The WWTF is regulated under the Type 1.09 General Aquifer Protection Permit (GP) pursuant to Arizona Administrative Code (A.A.C.) R18-9-B301(I). According to rule, the Type 1.09 General Permit (GP) applies for a sewage treatment facility with flows less than 20,000 gpd that was approved by ADEQ and started operating prior to January 1, 2001. The Type 1.09 General Permit restricts flows to less than 20,000 gpd and also *does not allow alteration of the treatment or disposal characteristics* of the original facility except as allowed under A.A.C. R18-9-A309(A)(9)(a). The meaning of this rule citation is discussed further later in this section. Flows cannot expand/increase above either the facility design flow (which for this facility is considered 15,000 gpd) or 20,000 gpd, whichever is less. To continue to operate under the Type 1.09 GP the facility must not contribute to a violation of an AWQS. Types of wastewater received by the facility are restricted by the General Permit and the facility cannot create an environmental nuisance. The Type 1.09 GP applies for the life of the facility, except as discussed below.
Plant Flow and Current General Permit A.A.C. R18-9-A301(l)(f) - The current Type 1.09 GP for 20,000 gpd applies for life of facility as long as no “non-routine” modifications are performed as that term is defined in A.A.C. A309(A)(9)(a) and (b):

“i. Converting a facility from operation only under gravity to one requiring a pump or other powered equipment for treatment or disposal;

ii. Modifying or replacing a facility operating under the 1.09 General Permit with a different type of treatment or disposal technology;

iii. Changing the treatment works or disposal works of a facility authorized under one or more Type 4 General Permits to a technology covered by any other Type 4 General Permit;

iv. Extending the disposal works more than 10 feet beyond the footprint of the original disposal works;

v. Reconstructing any part of the disposal works in soil that is inadequate for the treated wastewater flow or strength;

vi. Expanding the footprint of the facility into or within setback buffers established in R18-9-A312(C);

vii. Reconstructing the disposal works so that it does not meet the vertical separation requirements specified in R18-9-A312(E);

viii. Modifying a treatment works or disposal works to accommodate a daily design flow or waste load greater than the daily design flow or waste load applicable to the original facility; or

ix. Replacing the treatment works.”

These items all go beyond the provisions of the general permit and result in the loss of the grandfathered general permit by the permittee. The Type 1.09 GP is a permit by rule and the permittee can operate under the rule provided the conditions of rule are satisfied. Plant replacement, expansion or modifications to the current plant are outside of the conditions of general permit established in rule. In order to operate either a new or modified/expanded WWTF PCWMD has two options: either obtain a Type 4 General Permit; or, obtain an individual APP prior to start up of the new or expanded plant. If reclaimed use is selected for the disposal option, then an individual APP is needed for the reclaimed classification.

To obtain an individual APP, a new, upgraded, or expanded WWTF will be required to make five demonstrations - zoning, technical capability, financial capability, demonstration of compliance with standards at a Point of Compliance
(POC), and Best Available Demonstrated Control Technology (BADCT). The most critical of these for a WWTF design is the BADCT. An expanding or new WWTF is required to achieve new facility BADCT treatment performance standards in A.A.C. R18-9-B204(B). Minimum standards specified in rule are: secondary treatment levels: denitrification; pathogen removal (two sets of standards, one for a facility that discharges over 250,000 gpd, and one for less); minimization of trihalomethanes; and, removal of constituents identified in AAC R18-11-406(B) through (E) using industrial pre-treatment. The quality of treated effluent is required to meet these standards for a new WWTF or for interim upgrade of the facility or for long term expansion of the plant.

Upgrade and/or Expansion - Upgrade or expansion of WWTF will mean that the facility is no longer eligible for the current general permit. As the plant is modified and new or expanded discharge options are explored, some of these options may result in the need to obtain additional individual permits. Offsite treatment performed in storage tanks would by statutory requirement also need an individual APP, if considered wastewater treatment units.

In addition to BADCT treatment performance standards, a permittee is required to demonstrate that effluent quality will meet Aquifer Water Quality Standards (AWQS). Depending on the disposal option, the demonstration of compliance with AWQS may be at the end of pipe versus in the aquifer. Little is known about groundwater beneath the WWTF, therefore without additional studies it is unknown how Point of Compliance locations would be situated for a particular disposal option. If a demonstration of compliance with standards is made at the end of pipe, for most disposal options, groundwater monitoring would not be required, unless the monitoring is needed to demonstrate there is no hydrologic connection with Sabino Creek.

Outfalls - If new outfalls are added or discharge to outfalls is increased, the current AZPDES permit will require revision or a new AZPDES permit needed for discharge to Sabino Creek, and the outfalls will require permitting through an
individual APP. For example, a discharge to an outfall is a point source discharge to a navigable water and is considered a categorical discharging facility by statute ARS §49-241(B)(9) under the APP program, requiring a permit. The outfall may be included in the individual permit for the WWTF or if not contiguous, be separately permitted. If the current WWTF is modified either through upgrade or expansion, additional individual permitting requirements may apply for outfalls, if outfalls are used as a disposal option. Outfalls require an Aquifer Protection Permit and discharge quality limitations are put in the APP for the outfall.

Total Reclaimed Use – For this disposal option, an individual or general permit is still required for the WWTF, which is a categorical discharging facility pursuant to ARS §49-241(B)(10). If treated effluent is applied in the reclaimed area at consumptive use rates for the types of trees or plants grown, and is not considered disposal, then the application does not meet the definition of discharge in the APP program and the reclaimed area does not typically require a separate APP, only a reclaimed permit. APP related monitoring requirements are then put in the individual APP for the WWTF. From a planning perspective it is worth noting that ADEQ typically requires that consumptive use demonstrations be made on a monthly basis - comparing uptakes for the target plants in the different seasons with the intended application rate to show that the application is irrigation and not disposal.

The time required to obtain an individual permit for the WWTF is approximately 18 months. A flow chart of the APP permitting process is included as Figure 3-3 (end of text). If this impact to the project schedule is not ideal, PCWMD may request that the application be processed under the Expedited APP Program Using Third Party Contractors. The current cost for expediting an APP for a WWTF is approximately $100,000.00, and in many cases if the applicant is responsive a permit can be obtained within 6 months of the date of application.
This assumes that PCWMD has resources available to closely coordinate with ADEQ in this program.

Collection System Permitting – It should be noted that depending on which direction PCMWD decides to head for sewage collection and connections individual APP requirements may apply to some form of collection and flow equalization systems or systems that collect and provide primary treatment, if those systems do not exactly meet the Type 4 general permit requirements. This may result in the need to obtain another permit.

Recharge – recharge has not been carried for forward as a feasible options due to the hydrogeologic setting of the WWTF. There is insufficient land to develop recharge basins and as discussed in this report, the geologic formations present beneath the WWTF are hardrock. A significant and costly fracture assessment and hydrologic study would be required to assess whether fractures are present in the vicinity of the facility which could receive water. If however, these two limitations could be overcome, recharge would require an individual APP.

Storage Tank – One of the management options identified by EEC in this study is development of an off-site storage tank to hold treated effluent for use as water supply in fire-fighting efforts and possible storage before reclaimed use application if reclaimed water is used for irrigation of trees. This storage tank would be exempt from APP requirements if located offsite and used to hold treated effluent that meets the requirements of the USFS Special Use Permit. This would address short term needs to have a water supply available for firefighting, whether in response to private dwelling fires or fire fighting efforts in the Coronado National Forest. A storage tank can be developed as part of short term upgrade options.

Long term development may result in the need to obtain an individual Aquifer Protection Permit if treatment systems are added to this tank to ensure that stored water does not stagnate.
3.3 AZPDES Requirements & Impact on Option Feasibility
AZPDES and Outfalls - Currently, all the treated effluent from the Mt. Lemmon WWTF is sent to a spray field irrigation area where it is applied on natural forest vegetation, or is disposed via underground pipes leading to three combined outfalls, which discharge to unnamed washes which lead to Alder Canyon, Alder Wash which is a tributary to the San Pedro River. Discharge to the outfalls rather than the spray field occurs during freezing conditions and periods of upset or maintenance of the spray field irrigation system. The treated effluent is currently applied in the spray field without a reclaimed permit and is considered disposal by land application under the APP program, since effluent is not applied at consumptive use application rates and is sometimes discharged to outfalls. Under present operations discharge to the unnamed wash only occurs during freezing or inoperable conditions of the spray field and is regulated by an Arizona Pollutant Discharge Elimination System (AZPDES) permit which was issued by the Arizona Department of Environmental Quality (ADEQ) in December 2006. The current permit contains variances for concentrations of copper and zinc and regulates the quality of discharge from the WWTF to three outfalls at the spray field disposal area. These are discussed further below.

AZPDES permits require renewal every 5 years. The current Mount Lemmon WWTF AZPDES permit, issued for discharge to the three outfalls in the San Pedro Watershed, expires at the end of 2011. The pathway for upgrade of the WWTF by replacement would work towards amendment of the AZPDES permit to allow plant startup in 2011.

The AZPDES permit contains effluent limitations for: flow; biologic oxygen demand (BOD); E. coli; Total Suspended Solids (TSS); Copper; Zinc; Total residual Chlorine (TRC) and pH. The permit requires trace substance monitoring for: antimony; arsenic; beryllium; boron; cadmium; hexavalent chromium; cyanide; lead; mercury; nickel; selenium; silver; sulfides; thallium; and hardness. Effluent characterization testing is required for temperature; oil and grease; phosphorous; ammonia; chlorine; dissolved oxygen; total Kjeldahl nitrogen;
nitrate/nitrite; total dissolved solids (TDS); and total recoverable metals. Whole Effluent Toxicity (WET) testing is required for chronic toxicity also with action levels set in the permit. Standards established in the current permit are for an effluent dependent water (EDW) for tributaries to the San Pedro Watershed.

It should be noted that the SWQS were last revised in 2003 and are subject to triennial review by ADEQ. Draft rules are currently under public review for the current triennial review. The next triennial review is scheduled for 2010. The importance of this is discussed later in this section. The applicable surface water quality standards for possible future discharge to Sabino Creek (if this disposal option is carried forward) and to the current discharge limitations for the AZPDES permit for the Mt. Lemmon WWTF are included in Appendix L Comparison of Effluent to SWQS along with a summary of influent and effluent quality for the WWTF. Appendix M contains a comparison of the current SWQS with SWQS proposed in draft rules.

AZPDES Compliance Status – PCWMD ceased discharging from the WWTF to the outfalls after January 2002 due to decreased flow to the plant. Discharge to the outfalls has not resumed as of the date of this study and PCWMD has indicated that discharge to the outfalls will not be resumed except as a contingency response action (email communication between Kristie Kilgore of EEC and Tom Berry of PCWMD, June 14, 2007).

At the time the AZPDES permit was issued in December 2006, ADEQ files indicated that no significant AZPDES violations had been noted for the facility for the former discharges to the outfall.

Amendment of Current AZPDES Permit – to expand/increase discharge to the three outfalls in the current Spray Field, the AZPDES permit would need to be amended. This process could take 15 to 18 months. A flow chart of the AZPDES permitting process is included as Figure 3-4, AZPDES Permitting Process Flow Chart (end of text). Figure 3-5 shows the outfalls in the current
AZPDES permit which discharge in the San Pedro Watershed north of Summerhaven and over a ridgeline. The outfalls drain to unnamed washes which lead to Alder Canyon, Alder Wash and then to the San Pedro River (Figure 3-6). The distance to the San Pedro River from the outfalls is approximately 18.4 miles.
New AZPDES permit – Discharge to Sabino Creek, assuming the prohibition in the Surface Water Quality Standards is lifted through rule revision, will require a new AZPDES permit. Sabino Creek is not currently listed as an effluent dependent water (EDW) and this will affect standards established in the permit that would be needed for an outfall to the Creek.

Sabino Creek is currently designated for the following uses: Drinking Water source (DWS); Agricultural irrigation (AgI); Fish Consumption (FC); Full Body Contact (FBC); Aquatic and Wildlife cold water above latitude 32 degrees, 23 minutes, 28 seconds North and longitude 110 degrees North, 47 degrees, Zero Seconds West (Figure 3-7, Surface Water Quality Standard Designation Change); and Aquatic and Wildlife warm below this point. The Surface Water Quality Standards (SWQS) for these uses require that even if the prohibition is lifted, the effluent discharged to the Creek must achieve a quality sufficient to meet the standards for all the designated uses. The qualify of effluent from the current WWTF without upgrade or source control to reduce copper and zinc in influent would not meet the standards for chlorine residual, copper, zinc, total trihalomethanes, and various forms of nitrogen. Upgrade of the plant to meet new facility BADCT treatment performance standards established in rule AAC R18-9-B204 will require dechlorination or THM reduction, and de-nitrification. Compliance with standards would be achieved through upgrades to the plant. Copper and Zinc levels found in influent to the WWTF and effluent would necessitate additional treatment or source control to meet SWQS set in current and proposed draft SWQS rules, if site specific standards cannot be adopted.

As part of this study, a comparison of current surface water quality standards (SWQS) to the quality of the effluent discharged from the current Mount Lemmon WWTF was performed. Effluent is currently discharged to a spray field located in the San Pedro Watershed, not the Sabino Creek watershed so this comparison was performed for the purposes of planning and assessing needed upgrades to the WWTF to meet standards if the rules prohibiting discharge to Sabino Creek
are revised to allow this discharge. The comparison of the standards to effluent quality resulted in 53 occurrences of exceeded values for effluent quality for surface water quality standards. The majority of exceeded values were for DWS designated use standards and acute and chronic A&W cold and warm standards. The 13 constituents with concentrations in the current WWTF effluent that exceeded standards for Sabino Creek were: total residual chlorine, pH, dissolved oxygen, temperature, ammonia, nitrate, nitrite, nitrate-nitrite, copper, cyanide, zinc, bis (2-ethylhexyl) phthalate, chloroform, and THM. Results of the comparison are shown in Appendix L, Comparison of Effluent to SWQS Standards. Again, these exceeded values have been identified for the purposes of planning treatment plant upgrades. Effluent is currently not discharged to Sabino Creek.

ADEQ recently completed and published the draft version for proposed rules for the triennial review of SWQS and a draft copy was available for public comment in July 2007. A comparison of the current and draft standards are shown in Appendix M, Comparison of Draft to Current Rule SWQS. The designated uses for Sabino Creek are unchanged from the current uses; however, upon the arrival at the valley floor, the A&W use becomes warm water instead of cold water through the confluence with the Tanque Verde River so as above, the warm water standards were included in this comparison also. As a result of the changed standards, four additional exceeded values were added and one was removed. The four constituents and respective designated uses which were added to the list with exceeded values are chlorine (FBC), ammonia (A&Wewedw chronic), nitrite (FBC), and dichlorobromomethane (FC). The exceedence dropped from the list was bis (2-ethylhexyl) phthalate (FBC). The majority of exceedences remained largely unchanged. The draft standards for cadmium, copper, lead, nickel, silver and zinc are no longer determined by equations provided in appendices c-j of the current standards. Instead of utilizing equations to calculate standards, the draft standards utilized tables 3-22 in rule which provide a level of hardness in mg/L and a corresponding limiting quantity in μg/L.
Linear interpolation was used to calculate the standard for a given hardness. Pentachlorophenol had both equations and standard tables in the draft rules, however only the equation method was utilized. Due to the different methods of calculating standards (equation or interpolation), there were minor differences due to rounding in the resulting standard. Copper, nickel, and zinc were the only three constituents affected by rounding differences and are denoted in the table by footnote k.

**Site Specific Standards for Copper and Zinc**

The proposed draft SWQS rules include a procedure for petitioning ADEQ to set site specific standards for constituents. As a part of assessing whether such a demonstration may be successful, EEC reviewed available data for Sabino Creek at the sampling location just below Summerhaven. The chart of data is presented below. It suggests that levels currently in the Creek are well below those in current treated effluent and influent.

![Copper Concentration Chart](image)

Figure 3-8 Comparison of Copper and Zinc Concentrations in Influent, Effluent & Sabino Creek

EDW rule change requirement – Sabino Creek is not currently listed by rule as an effluent dependent water (EDW) in A.A.C R18-11-113. In AAC R18-11-
113(A) the ADEQ Director has the authority to reclassify a surface water body and EDW and R18-11-113(B) gives the Director the discretion to set site specific EDW standards. PCWMD can submit a petition for rule revision not only to lift the prohibition for discharge to Sabino Creek but also to designate Sabino Creek as an EDW and set standards appropriately. The most likely time that this rule change would occur would be during the next triennial rule review in 2010. However, it should be noted that given the current designated uses of Sabino Creek, this rule revision petition may be very challenging and result in unfavorable community perceptions since Sabino Creek flows through a recreation area that is managed by the USFS. If a NEPA EA is required (section 3.1 of this report), attempts to make standards less restrictive may involve greater public involvement or may not be accepted by ADEQ.

Site Specific Standards for Sabino Creek for Copper and Zinc – If elevated levels of copper and zinc that are found in influent to the current WWTF cannot be controlled at the source, PCWMD has two options for moving forward to address these constituents in treated effluent and for discharge to Sabino Creek. One option is to add additional treatment to the WWTF as part of interim upgrade (and expansion) that remove Copper and Zinc. The second option is to petition ADEQ to set site specific standards for these constituents as part of rule changes requested in 2010. Justifications and methods for setting site specific standards are in the proposed draft SWQS rules (2007). Based on the draft rules, comparison of effluent quality to background levels is one method for justifying setting standards.

EEC performed a brief comparison of available effluent and creek data to assess if this is feasible. At a preliminary review it does not appear that site specific standards is justified based on background data. The data set is however, limited.

Using ADEQ and PCWMD data, EEC performed a comparison of Copper (Cu) and Zinc (Zn) concentrations in micrograms per liter (µg/L) between the surface
water and treated effluent from the Mt. Lemmon WWTF. The comparison revealed that the concentrations of both metals are higher in the effluent than in the potential receiving water. No statistical analysis was done given the limited size and quality of the data set.

<table>
<thead>
<tr>
<th>Metal</th>
<th>Surface Water Conc. (µg/L)</th>
<th>Effluent Conc. (µg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ave</td>
<td>Max</td>
</tr>
<tr>
<td>Copper</td>
<td>8.26</td>
<td>18</td>
</tr>
<tr>
<td>Zinc</td>
<td>18.16</td>
<td>51</td>
</tr>
</tbody>
</table>

The minimum concentration of zinc in the effluent is over three times the average concentration found in Sabino Creek downstream of Summerhaven, while the minimum concentration of copper reported in the effluent is slightly lower than the average concentration of surface water. The maximum concentrations of both elements in the effluent are higher than those found in surface water. The reported zinc maximum concentration is higher than that of surface water by one order of magnitude, and is likely statistically significant. More data and statistical analysis are required to determine if these differences are actual differences in water quality or are an effect of limited sampling. In order to provide seasonal information and sufficient data for statistical evaluation, a total of 12 monthly rounds of data for the creek at a designated sampling point (by latitude and longitude) are needed.

Other methods for setting site specific standards are also presented in the proposed draft SWQS rule (2007). It should be noted that low to negligible flow in Sabino Creek may limit the types of models that can be used to set site specific standards.

All methods in draft SWQS rule that might be used to set site specific standards will require collection of additional data and there is no guarantee of success given the current effluent quality and conditions in the creek. Further, geologic
assessments included as part of this study suggests that formations which are the source of drinking water for Summerhaven contain copper and zinc and are mined for these minerals. This appears to be affecting the quality of water obtained by MLWID and the influent to the WWTF. While source water and WWTF influent water contains these constituents at elevated concentrations, Sabino Creek contains relatively lower concentrations by comparison. This makes petitioning for site specific standards challenging. Costs for sampling required for site specific sampling may be high and a demonstration may still not be possible. Therefore this study recommends that advanced treatment be added to the WWTF to achieve compliance with current standards rather than pursuing site specific standard demonstrations and rule revisions.

3.4 Other Relevant Regulatory Programs and Impact on Options

Reclaimed Use and Permitting

In a 2002 letter to former PCWMD Director Kathleen Chavez, P.E., Marcy Mullins of ADEQ indicated that irrigation of natural vegetation was not considered beneficial reuse as defined by the Reclaimed Water Rules (A.A.C. R18-9-701(1)) and therefore was not subject to requirements of the reclaimed program. ADEQ vacated the reclaimed permit for the Mt. Lemmon spray field (Mullins, 2002).

Direct reuse of reclaimed water recycles treated effluent for beneficial uses to conserve potable water sources for human consumption and domestic uses. At Mount Lemmon where water resources are extremely limited, beneficial use to offset use of potable water is an important goal. Regulations apply to wastewater treatment facilities supplying reclaimed water and to application sites.

For the purposes of this study, a reclaimed water permit, whether individual or general is required for:

- An owner or operator of a sewage treatment facility that generates reclaimed water for direct reuse
- A reclaimed water agent
- An end use of the reclaimed water if that end use is by someone other than the generating facility owner or operator if there is not a reclaimed agent

All wastewater treatment facilities providing reclaimed water for reuse must have an individual Aquifer Protection Permit (APP) with a designated reclaimed water classification. That means that the Type 1.09 general permit currently in place is not sufficient to support reclaimed uses. An individual APP for the WWTF is required. The individual APP requires monitoring and reporting of reclaimed water quality to ensure that treated effluent meets effluent limitations for reclaimed water quality classes.

An option is provided for a person or entity to act as a reclaimed water agent for multiple end users. The reclaimed water agent operates under a general or individual reclaimed water permit and allows end users to receive reclaimed water for appropriate reuse applications without having to notify ADEQ. For example if a wastewater management district or water reclamation district were formed at Mt. Lemmon, such an entity or PCWMD could act as a reclaimed agent for the distribution of reclaimed water.

Reclaimed Water Classes – Reclaimed water permits are valid for a period of 5 years. Five classes of reclaimed water have been established in rule in A.A.C. R18-11-303 through 307. These are expressed as a combination of minimum treatment requirements and a limited set of numeric reclaimed water quality criteria. Class A reclaimed water is required for reuse applications where there is a relatively high risk of human exposure to potential pathogens in the reclaimed water. For uses where the potential for human exposure is lower, Class B and Class C are acceptable. It is important to note that new facility BADCT treatment performance standards for an individual APP are essentially equivalent to A+ reclaimed water classification, with the exception of filtration for turbidity requirements, and depending on the capacity of the WWTF, disinfection
requirements for pathogen reduction. The “plus” or “+” sign for A+ and B+ reclaimed classification pertains to denitrification.

Classification Requirements for direct reclaimed uses can be found in A.A.C. R18-11-309, Table A. Based on review of limited data, the current WWTF produces treated effluent that is roughly equivalent to Class B quality. Pursuant to A.A.C. R19-9-703(C)(2), the class of reclaimed water is required to be identified in the individual APP for the WWTF for reclaimed use and reclaimed water may only be provided only from a WWTF under an individual APP pursuant to A.A.C. R18-9-704(A). This means that an individual APP is required for the WWTF to send effluent for reclaimed use for any of the uses under consideration in this section. Based on A.A.C. R18-11-309, Table A, relevant classification requirements for options explored in this section are:

- Residential Landscape Irrigation and Open Access Irrigation – Class A
- Fire Protection Systems – Class A
- Snowmaking – Class A
- Dust Control – Class B
- Irrigation of non food fiber, seed, forage and similar crops - C

If reclaimed use is phased in immediately for this WWTF at its current capacity, plant improvements may be needed to achieve the quality of effluent listed in the bullets above and an individual APP obtained to list the reclaimed classification. The individual APP permitting process could be started immediately if plant improvements could be rapidly designed to achieve Class A and new facility BADCT treatment performance standards without undergoing a full expansion of the plant. It should be noted that adding additional treatment trains would be considered a major modification and the Type 1.09 general permit would no longer be valid.

ADEQ typically requires at least 5 days of holding capacity at the reclaimed site to allow storage during periods of wet weather when reclaimed water cannot be
applied. Storage also provides a buffer to the reclaimed area during period of plant upset to make sure water is available to meet irrigation needs. The five-day requirement is not in rule but is a current implementation practice. Five-day storage can be provided with either a tank or an impoundment. Given the elevation of the site, freezing conditions during winter and limited land available, an impoundment may not be feasible to provide this storage. The benefit of using a tank is that it may also be accessed for water supply for fire fighting – especially if the tank is open on top or is connected to a dip tank which is used for helicopter access. This option is shown on Figure 3-9, Parallel Development Paths presented in this section.

Two primary reclaimed options have been carried forward as feasible for this project and consistent with plan objectives: reclaimed use to irrigate trees to reforest the area surrounding Summerhaven and improve visual resources as part of fire recovery/rehabilitation; and use of reclaimed water for fire-fighting. Both of these use reclaimed water classified as A or A+. A Temporary Emergency Waiver (TEW) can be obtained from ADEQ for use of the current effluent, which is B quality for fire fighting.

Individual Reclaimed Permits - An individual permit is required for the reuse of industrial wastewater that contains a component of sewage or is used in processing any crop or substance that may be used as human or animal food. Since influent to the WWTF does not include industrial wastewater and none of the options include food crops, an individual reclaimed permit would not be applicable for options in this study.

General Reclaimed Permits – Type 2 and 3 General Permits are valid for 5 years. Several types of general permits may apply for options associated with this project. For total reclaimed irrigation on forest or private land, as suggested above, PCWMD or an established management district may become a water agent for distribution of reclaimed water to multiple end users. This is a Type 3 reclaimed general permit. Because the WWTF expansion or a new WWTF will
be required to achieve new facility BADCT treatment performance standards for discharge quality, the only other two reclaimed general permits that may apply are the two type 2 general permits for the A classification, which is the class needed for the proposed disposal options: A.A.C. R18-9-712 for A+ (denitrification) and A.A.C R18-9-713 for A classification.

**Stormwater Permitting**

In order to reduce potential impacts associated with construction activities to surface water quality, the AZPDES program requires permitting for specific types of construction activities. A draft of the Construction General Permit was published in the Arizona Administrative Register on January 10, 2003. Construction is classified into large and small for the purposes of this program. Large construction activity refers to the disturbance of 5 or more acres. It also refers to the disturbance of less than 5 acres of total land area that is a part of a larger common plan of development or sale if the larger common plan will ultimately disturb five acres or more (40 CFR 122.26(b)(14)(x)).

Small construction activity refers to the disturbance of 1 or more, but less than 5 acres of land. It also refers to the disturbance of less than 1 acre of total land area that is part of a larger common plan of development or sale if the larger common plan will ultimately disturb 1 or more, but less than 5 acres (40 CFR 122.26(b)(15)).

To obtain authorization for discharges of stormwater associated with construction activity, the operator must submit a Notice of Intent (NOI) to ADEQ before beginning construction and comply with all the requirements of the general permit during construction activities. The operator as defined for this permit may be the owner, developer or contractor(s). Permitting includes requirement for a stormwater pollution prevention plan (SWPPP). Requirements for submittal of the SWPPP with the NOI versus having the SWPPP onsite depend on whether or not the site is located within ¼ mile of a unique (established in rule AAC R18-11-112) or impaired (303D List) water. None of the construction activities for this
project are expected to be located within this distance of either an unique or impaired water.

**Clean Water Act Section 404 Permitting**

Section 404 of the Clean Water Act (CWA) establishes a permitting program regulating excavation in waters of the United States. The definition of what constitutes “waters of the US” and jurisdiction over those waters may be affected by a recent decision by the US Supreme Court in Rapanos v. United States and Carabell v. United States (“Rapanos decision”). The implementation and applicability of this and other CWA program may change as the affects of the Rapanos decision are better understood. Section 404 permitting may apply if water is diverted from Sabino Creek or the stream bed is modified in any way as part of construction of an outfall. It may also apply for construction of new reclaimed use areas if landscape architecture is needed to prevent ponding and runoff and development requires construction over drainages. (This is unlikely as disturbance can be minimized through proper landscape architecture design which is proposed in this report).

The program is administered by the US Army Corps of Engineers (Corps) and EPA. Consultations are often performed with other agencies during the 404 permitting process such as Arizona Department of Game and Fish, and the US Fish & Wildlife Service. In the process ADEQ actually provides the 404 certification, which includes stipulations of permit conditions and limitations. The program limits activities which result in dredge and fill in the floodway especially those that may degrade waters of the US. The applicant must show they have taken steps to avoid impacts and performed compensatory actions for impacts which could not be avoided.

An individual permit is required for projects that have potential significant impacts. To initiate the process, an application form describing the proposed activity is submitted to the Corps. A review and revision process follows submittal. Once the application is deemed complete, the Corps issues a public
notice containing the information needed to evaluate the likely impact of the activity. Notice is sent to all interested parties including adjacent property owners, government agencies and others who have requested notice. A hearing may be requested during the public notice period.

For discharges that have only minimal adverse effects, the Corps has developed general permits that can be issued on a nationwide, regional or state basis for particular types of activities (e.g., minor road crossings, utility line backfill, flood control projects). General permits are developed and require public notice and have the potential or opportunity for public hearing. Once issued, the general permit may be modified or revoked if the activities are found to have any adverse impacts. General permits are issued for a specified time period, usually five years. This is the most likely type of 404 permit that would be required for construction associated with the various options for this project.

ADEQ has authority to grant, deny or waive water quality certification for both individual and nationwide permits. The Corps cannot issue a permit, individual or general without ADEQ approval, waiver of certification, or where ADEQ has denied certification.

**Arizona Department of Water Resources and Active Management Area**
The Mt. Lemmon WWTF is located within the boundaries of the Tucson Active Management Area (AMA). ADWR requirements apply not only to recharge permits and obtaining recharge credits through underground storage and recovery of water, but also to recharge wells if used to recharge treated effluent. Permitting of a recharge project runs concurrent with the APP permitting process and may take up to 2 years for an underground storage and recovery project. It should be noted that while BADCT requirements do not apply to an USRP, they do still apply for the WWTF for treatment performance standards and effluent quality. EEC has not carried the recharge/injection option forward for disposal due to the geologic setting of the WWTF. Hydrologic studies necessary to even assess this as a viable option are likely to be costly and possibly inconclusive.
It should be noted that requirements such as water rights apply to withdrawal, transfer and use of water within the boundaries of the AMA. These requirements should be fully assessed prior to implementing water management strategies.

**Summary of Senate Bill 1182 – ADWR Assured Water Supply Exception**

The provisions of Senate Bill 1182 apply to the community of Summerhaven. The bill was approved and signed into law by the Governor of Arizona on April 16, 2007 and will remain in effect until it is repealed on September 1, 2014. The law gives the Director of the Department of Water Resources (DWR) a clear set of circumstances, which if met in total, allow the exception of a subdivision from the assured water supply requirement. The emergency measure applies to those subdivisions within an Active Management Area that were platted prior to 1973 and had the majority of the development before 2002. Additionally the law stipulates that the majority of structures must have been destroyed by fire and that the redevelopment will not significantly increase water use and will incorporate water conservation measures. A statement must appear on contracts for sale that DWR is unable to determine an assured water supply. Based on this new legislation, the community of Summerhaven has been granted exemption from obtaining an assured water supply designation (State of Arizona, 2007 and State of Arizona, 2007a).

**Certified Area-wide Water Quality Management Plan (208 Plan)**

The current 208 Plan for Pima County restricts the capacity of the Mt. Lemmon WWTF to 18,189 gpd and also prohibits discharge to Sabino Creek. In order to upgrade the plant beyond its current treatment capacity and to discharge to Sabino Creek, the 208 Plan would need to be amended through the Pima Association of Governments (PAG). This step requires advance communication since PAG was originally involved in petitioning ADEQ to restrict discharge of wastewater to Sabino Creek. Successful petition to amend the 208 plan would depend in part on commitment by PCWMD to upgrade the plant to meet SWQS. The 208 Plan would need to be amended before initiating the APP permitting
process or the permit application will be halted in the administrative completeness stage pursuant to AAC R18-9-A201(6)(a).

**USEPA Underground Injection Control Program**

USEPA Underground Injection Control Permit – If PCWMD were to pursue installation of an injection well for subsurface injection of treated effluent, this would need to be inventoried with ADEQ and EPA Region 9. Injection of treated wastewater for recharge is unlikely to require a separate individual USEPA injection permit, but the possibility does exist. As stated above, this option has not been carried forward as feasible given the geologic setting of the WWTF.

**Sonoran Desert Conservation Plan**

As part of this study EEC reviewed relevant documents from Pima County to assess if any additional standards applied for Sabino Canyon that might affect discharge options or discharge quality. No additional requirements beyond those found the Arizona Surface Water Quality Standards and the 208 Certified Area-wide Water Quality Plan were found.

### 3.5 Compliance and Enforcement History & Impact on Option Feasibility

**Legal History, Consent Decree and Special Restrictions for Sabino Creek**

Prior to the early 1980s, PCWMD had a treatment system that consisted of a 5,000-gallon septic tank and a 1,200 square foot sand filter bed. The treatment facility was connected to a 3,850 foot clay interceptor system with approximately 48 connections. The treatment facility was located 400 feet below the Summerhaven/National Forest Service boundary between Sabino Canyon Park Road and Sabino Creek. Citizens filed a 60-day notice of intent to file a citizen’s suit under the Clean Water Act (CWA). The United States Environmental Protection Agency (USEPA) then filed action United States v. Pima County No. CIV-81-212-TUC-RMB (D. Ariz. Filed June 3, 1981) and the citizens intervened.
This action was based on exceedances of effluent permit limits and the possibility of impact to Sabino Creek. Protracted negotiation commenced which involved PCWMD, USEPA and the State of Arizona. As a result of the lawsuit and negotiations, a Consent Decree was filed with the District Court on July 12, 1982. According to PCWMD, the Consent Decree had the following specific terms and conditions of compliance which are significant to the discussion:

1. Only 47 properties could be hooked up to the wastewater treatment facility; and,

2. Discharge of treated effluent to the Sabino Creek Watershed was prohibited.

In response to the Consent Decree, PCWMD constructed the current WWTF at the south end of Summerhaven. As indicated above, at that time and in response to the requirements of the Consent Decree PCWMD began pumping the discharge from the facility which was and is located in the Sabino Creek watershed through a pipeline northeast through Summerhaven to a spray field discharge site and outfalls on the north side of the mountain. The spray field and associated outfalls are located in the San Pedro watershed – so this involved an inter-basin transfer of water.

Since the discharge point was relocated from Pima County land to USFS property, PCWMD was required to obtain a United States Forest Service Special Use Permit (SUP). An EIS was performed to satisfy NEPA requirements as part of obtaining the SUP. Given the small flow rates associated with the WWTF, there was a finding of no significant impact (FONSI) through the NEPA process and a special use permit was granted for up to 47 connections. That special use permit was amended in 2004 to add 30 connections for a total of 77 connections. The special use permit is discussed further later in this section.

The concept that treated effluent should not be discharged into the Sabino Creek Watershed was and remains important and is echoed in the consent decree, the
version of the NPDES permit that was administratively continued/extended in 1999, the Forest Service special use permit, and a prohibition was created in the Surface Water Quality Standard rules. Arizona Administrative Code (A.A.C.) R18-11-123(A) states, “The discharge of treated wastewater to Sabino Creek is prohibited.”

The prohibition on discharge of wastewater to Sabino Creek in place since the 1980s, was initiated in the 208 Certified Area-wide Water Quality Management Plan process with Pima Association of Governments (PAG), and was carried forward into the current Surface Water Quality Standard rules that are enforced by ADEQ and used by the AZPDES program. The current 208 plan also contains provisions restricting not only the capacity of the plant to 18,189 gpd, but also discharge to Sabino Creek. To change rules prohibiting discharge to Sabino Creek means first amending the 208 plan.

Although there is a consent decree associated with past discharges to Sabino Creek, at this time the WWTF appears to be in substantial compliance with APP and AZPDES requirements.

The occurrences of copper and zinc affect future options but may be addressed through identification of sources, and either additional treatment or source control where possible.

As indicated previously in this report, the prohibition of wastewater discharge to Sabino Creek was put into place in the 1980s. It is possible that views regarding wastewater discharge have evolved since that time. The effects of a long term drought have made the population generally more aware of topics such as sustainability of water supplies and conservation. If the prohibition is lifted, a discharge to the Creek which meets appropriate standards may improve base flow in the creek and result in return of water to the hydrologic cycle. The value of this may counter-balance possible negative public perception of effluent dependent water flow in a creek where full body contact is likely.
Other options such as recharge or total reclaimed use also have a net benefit compared to disposal through over-application. Recharge of the treated effluent restores water to the underground system, and is a deposit in the “water bank” which can be used to obtain ADWR credit. However, technical issues associated with the setting of this facility greatly limit many options that would otherwise be considered viable and desirable for a WWTF.

Beneficial use of the treated effluent to grow trees in an area that is recovering from a fire will result in aesthetic improvement and may ultimately help restore the area in other ways, such as contributing to reduction of sediment loads associated with post-fire erosion. There are limitations associated with this option such as the slope of the terrain and limited available land for use, but some areas of the Coronado National Forest may be suitable for this and located in proximity to possible storage sites or the WWTF. It is also possible that private landowners may be interested in reforestation for residential landscaping. To pursue this option additional work would be needed to identify suitable sites, to select a site, obtain permits, and then develop and construct an irrigation area. Developing beneficial uses within the Sabino Creek Watershed and upgrading the WWTF to obtain A+ quality reclaimed classification may help off-site resistance to revising rules that prohibit discharge.

**Wild and Scenic Rivers Act**

In addition to state regulations, Sabino Creek may be protected under federal regulations such as the Wild and Scenic Rivers Act. The Wild and Scenic River Act specifically:

- Prohibits dams and other federally assisted water resources projects that would adversely affect river values;
- Protects outstanding natural, cultural, or recreational values;
- Ensures water quality is maintained; and
Requires the creation of a comprehensive river management plan that addresses resource protection, development of lands and facilities, user capacities, and other management practices.

While Sabino Creek is not formally designated as a Wild and Scenic River, its rich-riparian habitat and recreational value may make it eligible for designation, especially in the upper reaches which are perennial compared to the lower reach through Sabino Canyon which is ephemeral.

3.6 County Permitting Authority, Requirements and Options
The Pima County Department of Environmental Quality (PDEQ) has been delegated the authority for issuance of onsite wastewater treatment (septic) system permits by the Arizona Department of Environmental Quality (ADEQ). Under state regulations, all on-site wastewater treatment systems are required to have an Aquifer Protection Permit. A system may qualify for Type 4.0 general permit if the design meets prescribed conditions set in rules. For systems that do not meet the Type 4.0 general permit conditions, the system must obtain an individual Aquifer Protection Permit (APP) through ADEQ. PDEQ has been delegated the Type 4.0 general APP program by ADEQ. ADEQ has retained the authority over individual APPs for onsite systems that do not meet the Type 4.0 design requirements.

In 2000, ADEQ adopted new regulations for onsite systems throughout Arizona. These new regulations require a more rigorous evaluation of site conditions and design parameters than were previously required under state regulations. These new regulations have impacted the development of new homes in Summerhaven as conventional systems can no longer be permitted on most lots and more advanced and expensive systems must be designed to meet the new regulations, given limiting site conditions. Pursuant to state regulations, existing conventional systems that were constructed prior to the new rules of 2000 were grandfathered under AAC R18-9-B301. These older systems were re-
certified/permitted as long as the system continued to operate in good working order and records were available for the system.

For lots in Summerhaven that previously had conventional systems and the structures were lost in the fire, as part of redevelopment, lot owners may approach PDEQ to recertify former septic systems. The former systems are not designed to meet the newer more stringent design standards that are now required under the new state general permit rules.

An overall Pima County policy and comprehensive wastewater management strategy are needed to define the use of onsite wastewater treatment systems for Summerhaven and address older systems that remain in the ground after loss of structures in the Aspen Fire. Older conventional systems and unclosed systems both pose a potential treat to public health and the environment by not providing adequate treatment of the effluent, the potential for effluent to surface due to limited soil conditions and bedrock near ground surface, sloping terrain, and the presence of rock outcroppings in the area. Improperly treated effluent and surfacing effluent may potentially impact local drinking water sources, including springs and domestic water wells within the Summerhaven Sewage Planning Area (SPA). As part of a comprehensive wastewater management strategy, Pima County should determine if a policy is needed that encourages homeowners in the area to connect to an upgraded WWTF versus reliance on on-site systems and conventional systems.

A comprehensive wastewater management plan for Summerhaven must take a close look at policy-making options that apply to Pima County permitting of on-site wastewater systems and address the need to protect public health and the environment. Pima County development standards and codes could potentially be used to restrict the use of on-site systems at Summerhaven.

Options to fast track the permitting of an upgraded WWTF for this community should be explored with ADEQ and plans should include installation of an
expanded conveyance system. Options such as forming a Sewage Improvement District and working together to address issues in Summerhaven should be included in planning discussions with PDEQ, PCWMD and ADEQ. A new WWTF and a SID with an expanded conveyance system together will offer homeowners a better choice compared to on-site systems in unfavorable terrain which may threaten the public health and environment of the Summerhaven community.

**Use of Federal Land and On-site Systems**

Aquifer protection permits, whether general or individual, are issued by ADEQ for facilities located on Federal land or at Federal facilities. Positioning of systems on Federal lands does not negate the need for the permits. Pima County DEQ does not have delegated authority for issuance of individual APPs – these must be issued by ADEQ at the Central Regional Office in Phoenix.

Public outreach may be needed to keep local homebuilders and wastewater system designers apprised of permitting requirements, specifically the subsurface and surface limiting conditions found in A.A.C. R18-9-A310(C) and (D)(2).

### 3.7 Recommendations

Evaluating options in a regulatory matrix table is useful for decision making. Based on the evaluation, there are several paths of least regulatory impact to the County. EEC recommends that parallel paths be pursued by Pima County and this is shown in Figure 3-9., Parallel Development Paths.

For short term flow rates, off site, private flow equalization results in the least impact to Pima County for short term but may not be well received by developers. This short term solution delays the need for WWTF upgrade and does not necessitate modification to the WWTF nor the need to obtain new permits or modify the current USFS special use permit. This solution, however, does not move the facility in the direction of preparing for long term needs and goals nor does it respond to objectives of the USFS that are clearly stated in the
current amended special use permit for conservation of water in the watershed of origin. Any modification/upgrade to the current WWTF will void the current Type 1.09 general permit and should be avoided until the County is prepared to move forward with obtaining an individual APP. Off site flow equalization eliminates the need to modify the facility.

Interim Development - The County could immediately pursue modifications to the current WWTF to improve discharge quality to meet reclaimed standards and new facility BADCT treatment performance standards for operation at the current capacity while the County pursues lifting the prohibition on discharge to Sabino Creek or replace the plant for interim upgrade and permit it for the current flow limits. Replacement of the plant is recommended in Section 5.0. Replacing the current plant with a 50,000 SBR plant results in the ability to accommodate and treat flows. Given uncertainties associated with flow projections and the size of homes being installed during redevelopment, replacement of the plant increases the Counties options and flexibility to accommodate requests for connection. This step results in the least amount of regulatory impact and begins to move the County in a proactive direction and towards achieving beneficial use goals such as providing water for firefighting to offset use of potable water for this activity. While it necessitates that the County obtain an individual APP for the plant improvements, amend the AZPDES permit and USFS SUP, and the addition of reclaimed classification to the individual APP permit, this improvement can be pursued immediately.

A storage tank can be added off-site without need to obtain a second individual APP if the tank is used for storage only and additional treatment is not performed in the tank. Under these conditions the tank is exempt by statute (ARS 49-250(B)(22). Although the effluent quality meets reclaimed B classification standard rather than A, treated effluent stored in an off-site storage tank located near the fire station north of Summerhaven could immediately be used for firefighting through a temporary emergency waiver from APP requirements.
(TEW) issued by the ADEQ Groundwater Section. A TEW can typically be issued by ADEQ in one to two days during an emergency situation and TEWs have been issued by ADEQ for use of wastewater for fire-fighting.

While pursing the individual APP for interim plant upgrade/replacement and amending the USFS SUP as needed, private land options could be identified by the County for phased implementation of growing trees for reforestation of Summerhaven, perhaps in cooperation with Trees for Mount Lemmon or through a seedling provider. An APP can be obtained in 18 months or less, once designs are in hand. NEPA requirements would not apply to this option if a private land option exists. If no private land can be found that is suitable for this use, then PCWMD can approach the USFS for use of Coronado National Forest for this purpose. It is possible that a Categorical Exclusion may apply, or that only an EA would be needed if the development of land does not impact threatened and endangered species and is seen as beneficial to recovery and rehabilitation from the two fires that have passed through the community.

Once land is selected for growing trees and designs and consumptive use models are in hand, obtaining reclaimed permit(s) typically only takes 6 months. Interim identification of small areas of land for reclaimed application and growing trees will begin to achieve the USFS goal of returning the water from the WWTF to the watershed and basin of origin if this land is located in the Sabino Creek Watershed rather than the San Pedro Watershed.

If the reclaimed water for interim development is applied on private land, the NEPA process is not triggered. If it is applied at consumptive use rates, an APP is not required for the reclaimed site(s), providing reclaimed water monitoring requirements are added to the individual permit for the WWTF. Reclaimed permits can be obtained as needed to address each phase of development of the irrigated land. As irrigated areas are developed, the discharge to the spray field and outfalls can slowly be decreased until this disposal option is no longer needed. For the short term the special use permit can be left in place for
contingency use. Success in developing irrigated areas depends on planting seedlings or saplings early on in the pathway development process and after interim upgrade to allow time for the trees to mature for maximum uptake of reclaimed water which correlates with increased influent flows to the WWTP from growth. As trees grown more reclaimed water will be taken up and this will begin to off-set increasing influent rates to allow PCWMD to operate without increasing the limits in the USFS SUP. Flow meters can be added to the storage tank to track flow to the spray field versus irrigated areas to ensure compliance with various permits.

Acquisition of a small amount of land either through special use permit, lease or purchase would allow the County to install a storage tank for short and long term holding needs for reclaimed water. Tanks that are not treatment units are exempt from APP pursuant to ARS 49-250(B)(22) so an APP is not needed for this storage. Storage will provide a buffer during winter periods when uptake is reduced or periods of wet weather. The tank would ideally be located at the north end of Summerhaven to allow gravity distribution to the community or land targeted for reclaimed irrigation within the watershed that is tributary to the Santa Cruz River rather than the San Pedro River. One possible site for this storage tank identified by the USFS District Ranger is at the old sawmill location by the firestation, on Coronado National Forest land. The USFS may support use of this area for construction of a 100,000 gallon tank if water from this tank can be used for fire-fighting, provided that the location of the tank does not interfere with helicopter access and regress. This tank could be designed to allow access to the reclaimed water supply for fire-fighting in addition to providing 5-day holding during wet weather and plant upset conditions.

Timelines developed in this study suggest that permitting and construction can be achieved to allow start up of the replacement plant in spring of 2011.

Long Term Development and Options – The interim step above begins to move the County towards long term needs. Expanding the plant to full build out to
serve the projected population and higher flow rates will require amendment of the APP, AZPDES and USFS SUP. The first individual APP would be obtained in the interim step and long term step would require only an amendment to a permit to accommodate increased discharge rates/flows. While the initial individual APP is being obtained in the interim development and the County works towards lifting the prohibition for discharge of wastewater to Sabino Creek, design work can begin to lay the necessary foundation for an amended APP. At the same time the County can acquire land through purchase or agreement with private land owners which is suitable and can be terraced and designed to receive the reclaimed water to accommodate phased growth and irrigation at consumptive use rates. If the reclaimed water is applied on private land for reforestation, the NEPA process is not triggered. If it is applied at consumptive use rates, an APP is not required for the reclaimed site, providing reclaimed water monitoring requirements are added to the individual permit for the WWTF. Reclaimed permits can be obtained as needed to address each phase of development of the irrigated land. An AZPDES permit is not required for this option. The storage tank developed during interim development can be sized to be suitable for 5-day reclaimed storage for full build out, or additional tanks added as needed to accommodate growth. Again, the tank or tanks can be made accessible to supply water for fire fighting for either dwelling/structure fires or forest fires.

Lifting of the prohibition on discharge to Sabino Creek is then a contingency step. This can be in hand in the event that the County wishes to develop an outfall for backup in the event that the reclaimed areas cannot receive effluent or if permitting and rule change efforts are successful, can be the primary disposal location. The process of obtaining an AZPDES permit for this discharge and negotiating standards and revising standards in rule can be pursued but on a more relaxed timeline once other interim options are achieved.
Pathways identified and recommended by EEC are shown in Figure 3-8 Parallel Development Path below and in the Schedule provided in Section 9.0. It is important to note that certain key steps to success depend on the preceding steps. The timelines shown in figure 3-8 and the schedule assume that regulatory steps can be achieved as indicated and may be realistic but do not represent worst-case scenarios. For example, if the ADEQ rule making process extends beyond one year from the initiation of the year of the triennial review, this is a delay in the project timeline and will result in delays in other key portions of the project. It is important that PCWMD be proactive in pursuing the parallel paths for each pathway in order to achieve success and allow buffers for unexpected events and possible delays. It is also important to note that pathways assume that certain activities be initiated in 2008, such as design of an upgrade to the WWTF to meet new facility BADCT treatment performance standards and SWQSs and collecting data to support the NEPA process, such as identifying sites for screening and assessing if these potential sites have T&E species issues. For example the land immediately west of the old sawmill may be the most feasible land for reclaimed irrigation of trees, assuming that this land can be accessed through the NEPA CE or EA process and a special use permit obtained. In order to achieve this, it must be compared to private land in the area based on technical development considerations and feasibility and ease of use issues.
Mt. Lemmon Parallel Development Paths

**Figure 3-9**

### WWTF Upgrade and Beneficial Use Options
- Design & Develop Reclaimed Strategies 2008
- 208 Plan Consistency Review 2009
- Obtain Individual APP A to A-BADCT Amend USFS SUP (as-needed) 2011

Next:
- Construct Upgraded WWTF
- Obtain Reclaimed Permits

**Increased Beneficial Use Options**
- Firefighting
- Reclaimed Reforestation
- Consumptive Use (application only)

### San Pedro WS Site Specific Standards Cu & Zn
- Off-site Storage Tank
- Develop Site Selection Criteria & Conceptual Design
- Identify Suitable Sites (USFS & Private)
- Screen Sites with Baseline Studies

Next:
- Yes: Private Site Available?
  - NO: Screen Sites with Baseline Studies
  - YES: Continue with Beneficial Use Options

**Project Scope:**
- Form Agreements for Use of Private Land
- Project Scoping & Site Selection
- Assess for Categorical Exclusion (CE)
- If No CE, Initiate NEPA

**NEPA Process**
- Develop Tank Site & Pipeline (Design & Construct)

**Continued Use of Sprayfield Option (until 2022)**

### Sabino Creek Discharge Option
- Perform Study for Site Specific Standards
- Petition for Rule Change 2010 Triennial Review
- Amend AZPDES Permit - Sprayfield

Next:
- NEPA Process
- Select Outfall Location
- Apply for Individual APP and AZPDES (assume no NEPA)

**Continued Use of Sprayfield Option (until 2022)**

### WWTF Expansion (2017)
- 208 Plan Amendment 2008 – 2010
- Collect Creek Data (as-needed) Perform NEPA & SWQ Studies
- (Option) Advanced Treatment for Cu and Zn Removal
- Petition for Rule Change – Lift Sabino Creek Prohibition & Set Standards 2010 – 2013
- Select Outfall Location
- Apply for Individual APP and AZPDES (assume no NEPA)

**Alternative Disposal Location Options**
- Outfalls to Sabino Creek
- Application as Disposal
- Snowmaking Options

09/28/07
4.0 Financial Issues

4.1 Bond Funding (capital)
On January 20, 2004, the Pima County Board of Supervisors passed and adopted Resolution Number 2004-18, ordering and calling for a special bond election to be held in Pima County, Arizona, on May 18, 2004. Pima County residents subsequently passed the sewer system bond package. This package included this study of the Mt. Lemmon WWTF and effluent disposal system. Below is the description of the bond for Mt. Lemmon sewer system.

Location: Village of Summerhaven along Sabino Canyon Parkway and immediate areas tributary to the existing sewer system.

Scope: To improve and expand the Mt. Lemmon WWTF and Effluent Disposal system in the area damaged in the Aspen Forest Fire of June/July of 2003 in order to better serve the needs of the greater Summerhaven area and to provide a source of reclaimed water for beneficial reuse, such as fire protection and subsequent recharge. Should this approval not be forthcoming, unneeded bond funds will be transferred to the Roger Road WWTP (Wastewater Treatment Plant) Infrastructure and Environmental Improvements Project for odor control mitigation purposes.

Benefits: Due to the extent of the Aspen Fire damage, and the anticipated rebuilding of the Summerhaven area, it may be necessary to reconfigure and expand the entire Mt. Lemmon public sanitary sewerage treatment system, including conveyance, treatment and effluent disposal/reuse systems. Initially the system was authorized to serve only 47 specific properties with the public sewer system and dispose of the correspondingly limited amount of effluent in a spray field to the San Pedro drainage. The impact of the fire and subsequent rebuilding of the Summerhaven area will result in a new master plan. There is also community interest in providing wastewater treatment for additional residential hook-ups in lieu of private septage disposal. The resulting development will require the expansion of the existing 12,500 gallon per day wastewater treatment facility, upgrade of the water quality treatment to meet environmental permits (AZPDES, APP and Reuse permits) and evaluation and siting of additional disposal areas.

Sewer Revenue Bond Debt is repaid through user and connection fees. Generally, when PCWMD sells bonds, sewer user and connections fees increase, though it is not possible to specify with accuracy how much those fees
will increase over the course of the bond program. Sewer user fees and connection fees are annually reviewed to ensure fees are adequate to support annual operating and maintenance costs. Once operating and maintenance costs are deducted from the annual projected revenues of the system, the remainder must be equal to 1.2 times the annual debt service payment requirement of the department, for both existing debt and any proposed new bond sales. If the coverage is less than 1.2 for existing debt then fees must be increased sufficiently to bring in the necessary additional revenues.

4.2 Other Financing Capacities

WIFA Loans
In addition to selling sewer revenue bonds on the municipal bond market, Pima County has the option of applying for loans from the Water Infrastructure Financing Authority (WIFA) of Arizona.

WIFA is an independent agency of the state of Arizona and is authorized to finance the construction, rehabilitation and/or improvement of drinking water, wastewater, wastewater reclamation, and other water quality facilities/projects. Generally, WIFA offers borrowers below market interest on loans for one hundred percent of eligible project costs.

WIFA’s principal tools for providing low interest financial assistance include the Clean Water Revolving Fund for publicly held wastewater treatment. This fund is capitalized by contributions from the state and the U.S. Congress. Funds can be used to plan, construct, rehabilitate, modify, improve, upgrade and/or equip and expand wastewater treatment and water reclamation facilities and related water quality projects.

WIFA also manages a Technical Assistance (TA) Program. The TA program offers pre-design and design grants and loans to all eligible wastewater and drinking water systems. Grant recipients are required to contribute a local match generally between 25-75% based on local fiscal capacity. There are significant
administrative costs associated with applying for and requesting reimbursements of WIFA loans that off-set the interest rate benefit to some degree.

**Community Development Block Grants (CDBG)**

The CDBG program provides communities with resources to address a wide range of community development needs. The program is administered through the U.S. Department of Housing and Urban Development (HUD) which provides annual grants on a formula basis to entitled cities, urban counties and states to develop viable urban communities principally for low and moderate income areas. The program is authorized under Title 1 of the Housing and Community Development Act of 1974. This program will likely not be available to the community due to the low income requirements.

**Greater Arizona Development Authority (GADA) Programs**

GADA was created by the Arizona Legislature to assist local and tribal governments and special districts with the development of public infrastructure. GADA is able to provide loans at lower interest rates with loan terms up to 30 years. GADA also provides Technical Assistance Grants and for early stage project development and Technical Assistance Loans to help fund projects in the final phases of development.

**USDA Rural Development Loans and Grants**

Under the US Department of Agriculture, The Rural Utilities Service’s Water Programs Division has four programs which provide financial and technical assistance for development and operation of safe and affordable water supply systems and sewage and other forms of waste disposal facilities:

- Water and Waste Disposal Loans and Grants
- Emergency Community Water Assistance Grants
- Technical Assistance and Training Grants
- Solid Waste Management Grants

These programs are administered by USDA Rural Development offices to provide low interest loans and grants to public entities to construct, repair,
modify, expand or improve water supply and waste disposal facilities; acquire
needed land, water sources and water rights; and to pay associated legal and
engineering fees. Certain other costs related to development of the facility may
also be covered.

**Arizona Water Protection Fund**

The AWPF provides grants for the development and implementation of measures
to protect water of sufficient quality and quantity to maintain, enhance and
restore rivers and streams and associated riparian habitats. The fund is
administered by the director of Arizona Department of Water Resources and the
State Land Commissioner. Any person or entity, state or federal agency, or
political subdivision of Arizona may submit an application for an AWPF grant.
Grants may be used to:

- Develop and implement capital projects or specific measures to maintain,
  enhance and restore rivers and streams and associated riparian resources.
- Acquire CAP water or effluent for the purpose of protecting or restoring
  rivers and streams.
- Develop, promote and implement water conservation programs outside of
  the five active management areas.
- Support research and data collection, compilation and analysis.

**Rural Water Infrastructure Committee (RWIC)**

Arizona RWIC is composed of representatives from various infrastructure loan
and grant programs, federal and state lending authorities, and technical
assistance providers. RWIC serves as a “One Stop” funding entity and technical
assistance resource for Arizona’s rural communities seeking assistance with
infrastructure projects. This entity could be utilized to streamline loan and grant
application processes.

**Other Organizations for Fund Requests and Inquiry**

Other entities that may be able to provide grant funds include the following:

- Marshall Fund of Arizona
- A.P.S. Foundation, Inc.
Improvement Districts

A county improvement district is a special taxing district that is established by the County Board of Supervisors at the request of the property owners within a specific area. The districts are created under Arizona Revised Statutes, Title 48, Chapter 6, for the purposes of installing local public improvements and distributing the cost for the improvements among the property owners within the district based upon the benefit derived.

The extent of the district boundary must be clearly identified at the onset and the petition for establishing and improvement district must be signed by the majority of the persons owning real property or by the owners of fifty-one per cent or more of the real property within the limits of the proposed district.

After a County improvement district is established, the properties within the district are subject to taxation or by special assessments, both of which are first liens on the properties. Improvement District bonds may be issued to finance the improvements and the property owners are assessed their portion of the debt over a ten year period or less.
Sewer Connection Fees and User Fees
Per Pima County Board of Supervisors, the schedule of sewer revenue bond sales is premised upon pledges to keep annual increases in Wastewater Management sewer user fees at 5 percent or less, and connection fees increased to 12 percent or less.

Property Taxes
General obligation bond debt authorized by the voters is retired through an annual levy of a secondary property tax assessed against the value of all property in Pima County. Per Pima County Board of Supervisors, the term of the debt is to be not longer than 15 years, and the secondary property tax rate required to pay off the debt is to be maintained at a relatively constant level, at or below $1.00 per $100 assessed value.

4.3 Effluent Asset Value
Typically the value of effluent is set by need for a water supply compared to costs of using drinking water for that same supply or impact of regulations on use of potable water for certain activities such as golf course irrigation – basic principle of supply and demand. As water becomes more scarce (as supply decreases) during a sustained period of drought, demand continues to grow regardless of the limit on the supply. This causes the economics of using effluent where potable water normally is used to become more viable,

Drought is affecting the availability of water in Summerhaven regardless of demand for water. In Summerhaven, although paper water rights exist to suggest that water is available to serve community needs, paper rights to not necessarily correlate with water availability and the ability of local water sources to meet needs. When water supply in springs is low due to lack of rainfall, MLWID has resorted to hauling water in trucks to fill tanks and supply customers. Local water supply in springs and wells could not meet the demand. This makes conservation necessary. It also increases the relative value and feasibility of
effluent to off-set normal uses of potable water. The limited supply increases the value of the effluent for reclaimed uses and beneficial uses.

If drought conditions continue this may also make toilet to tap indirect reuse of water mixed with potable water for consumption more feasible. Today state law prohibits use of reclaimed water for human consumption, but with continuing drought the level of interest in pursuing changes in state law could increase. In Cloudcroft, New Mexico, a community and situation very analogous to Summerhaven, the community turned to indirect reuse by mixing of highly treated effluent (tertiary treatment and reverse osmosis) with raw water to reduce reliance on groundwater in a bedrock and fracture system that had low yield of water. Cloudcroft achieved success by using effluent to reduce reliance on groundwater for drinking water. The limited supply of groundwater in the area and continuing demand collectively changed and enhanced the value of effluent – enough to overcome perceptions that are often associated with toilet to tap alternatives. If drought conditions continue and state law were revised, this alternative could become economically and socially viable in Summerhaven.

The main uses of effluent at Summerhaven that have been identified in this report include replacing use of potable water for snowmaking, irrigation, fire recovery, and for fire fighting with reclaimed water, whether for fighting forest fires or for fighting fires in homes in the community.

**Snowmaking at Ski Valley**

If a conveyance system and storage system were in place, the effluent could be used for snowmaking at Ski Valley. Reclaimed effluent may have value to the owners of Ski Valley, but currently that value has not been explored. This option has not been carried forward as feasible due to expected high permitting costs, likely resistance from Tribal Nations, and the possible cost of conveyance. If Ski Valley were interested in sharing permitting costs and paying for the conveyance, this option could become more feasible and the value of the effluent for this use
increased. The NEPA permitting costs and risks would have to be shown to worth while and success likely by a market study, which could include assessing the increased draw and attendance at ski valley for winter visitors resulting from improved skiing conditions.

Reclaimed Irrigation – currently reclaimed irrigation does not appear to have an economic advantage since customers have not been identified who are willing to pay the cost of obtaining effluent/reclaimed water for landscape irrigation. With development of resorts in the area, this possibility may increase in the future. Currently reclaimed irrigation to reforest the area and restore the visual resources has a value but it is not in the buying and selling of the effluent. The value is in moving from disposal of effluent down a canyon with no beneficial end result that is appreciable to Summerhaven to cultivating restoration of the visual terrain and beneficial use of reclaimed water from the WWTF to grow trees and stabilize soils as part of fire recovery and restoration. This value cannot easily be translated into dollars but will help in attracting visitors to the area and reduce post fire soils erosion which may impact surface water quality.

Fire Fighting Asset Value - Currently water for fire fighting is either supplied by MLWID or is hauled up to Summerhaven in trucks (such as during the Bullock and Aspen Fires). The cost of water for firefighting relates to transportation costs (vehicle mileage, wages of drivers, vehicle maintenance) plus the actual cost of the potable water is was obtained from City of Tucson. The transportation costs for hauling water by helicopter (based on a 12 mile round trip) are $0.88/gallon. This means that potential helicopter transportation costs alone for 100,000 gallons of water are $88,000.00. Water was also hauled by truck during the Aspen and Bullock Fires. Cost per gallon to haul water by truck is typically greater than $0.88/gallon. These costs do not include the actual cost of purchasing potable water for fire fighting supply. These costs suggest that treated effluent/reclaimed water has value to the community during emergencies.
Rather than disposing of the effluent as is the current practice, storing effluent in a tank for access during fire fighting, combined with reclaimed irrigation to restore resources, will reduce reliance on potable water for fire-fighting. Although there is a cost of this use to develop the tank site, in the event of an emergency and fire in the area, this cost could be off-set. It is possible that water may be sold for this use to the local community and USFS and still be significantly cheaper than the cost of the potable water being used in fire fighting events in the Catalina Mountains, if a fire were to happen again. This option is worth exploring with parties that may benefit from this use of the water including the community and the USFS.

### 4.4 Biosolid Disposal Costs

Currently biosolids from the WWTF are stored in an above ground tank, aerated to reduce odors and then are hauled off the mountain to one of three PCWMD manholes. The primary location is on Tanque Verde Road (manhole number 8716-03), the secondary is at Walker Road and the 3rd location is on Mission Road. Approximately 48 truckloads are hauled per year (one 1800 gallon truckload per week) (Gall, 2007). For this study continued use of this option was compared to other options for disposal.

The following disposal costs are based on the four treatment upgrades discussed in Section 5.2 and the 06-07 current WWTF disposal costs. Note that the current plant has an influent flow rate of 15,500 GPD and the three alternatives identified for WWTF expansion have influent flow rates of 50,000 GPD.

**Current Plant**

If the current WWTF runs a mixed liquor concentration of 5,000 mg/L (0.5% solids) and wastes sludge at that concentration, then transporting sludge by truck to a gravity manhole is the least efficient method of disposal. The direct disposal cost at the current loading is $6,550/yr. Using the Sludge Handling Tank as a gravity thickener and increasing the percent solids to 2% would cut the current cost to approximately $1,700/yr.
Adding an on-site digester (approximately 12-ft diameter at $150,000 capital investment) would reduce the volume by fifty percent, followed by a gravity thickener, and could reduce the hauling cost to $820/yr. However, there is a $2,000 electrical O&M cost which raises the disposal cost to $2,820.

Using just a belt filter press ($125,000 capital investment) could increase percent solids up to 15% reducing the hauled volume by a factor of 30. However, the sludge cake would require landfill disposal ($7,500/yr) for a total disposal cost of $7,720.

**Sequencing Batch Reactor (SBR)**

The *Fluidyne* SBR discussed later, generates 75% less raw sludge volume than the current plant’s extended aeration process for a baseline disposal cost of approximately $4,920. Since the sludge is digested to a Class B standard as part of the SBR process, gravity thickening and the use of a belt filter press would further reduce the sludge volume and lower the disposal cost to approximately $655. This method is consistent with the Regional Optimization Plan (ROMP) which recommends thickening, hauling and delivery to a regional facility for further processing (Gall, 2007).

**Membrane Bioreactor (MBR) and ADDIGEST MBR**

Both of these options are essentially the same, extended aeration followed by membrane filtration rather than a conventional clarifier. Because the process is run at a mixed liquor concentration 2.5 times higher than the current plant process the raw sludge volume and resulting disposal costs is approximately $7,860. By adding digestion, thickening, and the belt filter press to the process disposal costs are reduced to $400. Adding back a $6,000 electrical O&M cost raises the disposal cost to $6,400.
TABLE 4-1 MATRIX OF SLUDGE DISPOSAL OPTIONS

<table>
<thead>
<tr>
<th>TREATMENT PROCESSES</th>
<th>RAW</th>
<th>THICKENED</th>
<th>PRESS ED</th>
<th>DIGESTION ONLY</th>
<th>DIGESTED &amp; PRESS ED</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXTENDED AERATION</td>
<td>$6,550</td>
<td>$1,700</td>
<td>$7,720</td>
<td>$2,820</td>
<td>$2,700</td>
</tr>
<tr>
<td>SBR</td>
<td>$4,920</td>
<td>$2,500</td>
<td>$655</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>MBR/ADIGEST</td>
<td>$7,860</td>
<td>$3,930</td>
<td>$8,500</td>
<td>$3,930</td>
<td>$6,400</td>
</tr>
</tbody>
</table>

Considering the capital investment for both the Digester and/or the belt filter press, only gravity thickening with disposal into the current manhole is economically viable.

However, when evaluating options for disposal the public perception and stakeholder input must also be considered by PCWMD. In stakeholder meetings and interviews with key stakeholders performed as a part of this study, important stakeholders such as the USFS expressed concern that hauling represents a potential environmental hazard. Approximately 48 truckloads of biosolids are hauled down the highway from Mount Lemmon per year (Gall, 2007). Hauling by truck poses a risk for vehicular accident, and if an accident were to occur, environmental response and corrective actions may be needed which have an associated cost. Stakeholders also expressed concern that a contingency plan is currently not in place in case hauling cannot be performed due to weather or emergency situations such as fire. In forming recommendations for redevelopment, community input is important and must be weighed against the economics of options.

Upgrading the facility to include a SBR system will reduce sludge volume and reduce the number of truckloads to the regional facility, which is consistent with
the PCWMD ROMP. This process will thicken and dry sludge and result in 75% less sludge to haul than using extended aeration. Augmenting this with a belt press will reduce the volume of sludge by another 10%.

4.5 System Operation and Maintenance Costs

The O&M cost estimates in this section are based on the current WWTF 06-07 O&M costs.

The current plant equipment, which includes influent and effluent pumping, has a current O&M cost of $202,950 per year, including raw sludge disposal. The potential upgrade adds two new pieces of equipment that have O&M costs. The internal filter influent pump adds $500/year and the UV disinfection equipment adds $300/yr, for a total O&M cost estimated at $203,750/yr. See Section 4.4 for sludge disposal options that may be implemented to reduce O&M costs.

SBR

The Fluidyne ISAM SBR process has a very low O&M costs for several reasons.

- The equalization tank and second influent pump station are not required.
- The Denitrifying sand filter and influent pump are not required.
- The sludge from the anaerobic chamber is the lowest quantity and meets Class B standards.
- There are no air blowers for the aerobic portion of the process.

The estimated O&M costs associated with the SBR process including raw sludge disposal costs is approximately $198,169 operating at three times the current capacity. See Section 4.4 for sludge disposal options that can reduce O&M costs.

MBR

The MBR Process has a higher O&M cost because of the equalization tank requirement and second influent pump station ($500/yr), the air blowers ($6100/yr), the mixed liquor return pumps ($300/yr), and the occasional chemical cleaning required for the membrane filters ($1000/yr). The estimated O&M costs
associated with the MBR process, including raw sludge disposal costs, is approximately $209,860 operating at three times the current capacity. See Section 4.4 for sludge disposal options that can reduce O&M costs.

**ADDIGEST**

The ADDIGEST process is slightly higher than the MBR because of the added membrane filter feed pump and the chemical feed and permeate return/backwash pump. The estimated O&M costs associated with the ADDIGEST process, including raw sludge disposal costs, is approximately $203,209 operating at three times the current capacity. See Section 4.4 for sludge disposal options that can reduce O&M costs.

**ITEMIZED, ESTIMATED ANNUAL O&M COSTS:**

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Plant</td>
<td>$186,649</td>
</tr>
<tr>
<td>Second Influent Pump:</td>
<td>$500</td>
</tr>
<tr>
<td>Mixed Liquor Pumps:</td>
<td>$300</td>
</tr>
<tr>
<td>Air Blowers (10 BHP):</td>
<td>$6,100</td>
</tr>
<tr>
<td>SBR Internal Transfer pump and aspirator (10 BHP):</td>
<td>$6,100</td>
</tr>
<tr>
<td>UV Disinfection:</td>
<td>$300</td>
</tr>
<tr>
<td>Membrane Chemical cleaning:</td>
<td>$1,000</td>
</tr>
<tr>
<td>Permeate Return Pump:</td>
<td>$300</td>
</tr>
<tr>
<td>Higher Capacity Effluent Pump:</td>
<td>$200</td>
</tr>
<tr>
<td>Membrane filter feed pump (ADDIGEST only)</td>
<td>$600</td>
</tr>
</tbody>
</table>

**SUMMARY LIST:** Note includes raw sludge disposal cost.

1. Existing Plant with effluent quality upgrade but no change in capacity: $203,259
2. *Fluidyne ISAM* SBR at 50,000 GPD $198,169
3. MBR Process at 50,000 GPD $202,909
4. ADDIGEST at 50,000 GPD $203,809

With digester and Belt Filter press treatment of sludge

1. Existing Plant Upgrade: $199,409
2. *Fluidyne ISAM* SBR $193,904
3. MBR Process $201,449
4. ADDIGEST $202,349
5.0 Technical Issues

There are many technical challenges that will need to be addressed in order for the Mount Lemmon community to grow. The discharge permit limits PCWMD to serving 77 connections. The existing conveyance system has the capacity to convey the wastewater for the entire basin, however there is insufficient treatment capacity to treat it. In addition the current conveyance infrastructure is located mainly along Sabino Creek within the pavement of Sabino Canyon Park road. There is currently no infrastructure beyond this alignment, thus it has become a challenge to serve most of the Summerhaven community because most of it does not front the existing infrastructure. Expansion of the conveyance system would need to occur in order to allow more connections to the system.

Expansion to the treatment capacity for the Summerhaven community poses many challenges as well. The current treatment facility is a small treatment plant that can serve up to 77 lots. The property on which this treatment plant is located has many physical and technical limitations that affect wastewater management and planning. The lot is small and a large portion of it is occupied by the current treatment plant. Any treatment expansion would require this plant to remain in operation until the new plant goes on line. In addition there is a wash that runs through the site to the south and there are setback issues from neighboring property owners to the north and west of the existing lot. These restrictions severely limit the size of any future treatment facilities and ultimately the treatment capacity for the community.

In order to organize the various treatment and conveyance technologies possible for the Summerhaven community a selection matrix was used to evaluate and prioritize the various treatment and conveyance options. The participants of the selection process first established a list of weighted criteria for the conveyance and the treatment matrices and then each option was evaluated against the selected criteria.
Criteria identified for the conveyance matrix were as follows:

- **Operation and Maintenance (O&M) costs**: This criterion is based on present worth cost of maintaining and operating the conveyance system.
- **Capital Costs**: This criterion is the cost for the construction and installation of the conveyance system in 2007 dollars.
- **Rehabilitation & Replacement**: This criterion is the ability to rehabilitate and replace the conveyance system with minimal impact to the users.
- **Constructability**: This criterion is based on the ease or complexity of installing the conveyance system.
- **Individual Property Cost**: This criterion is based on the out-of-pocket expense to install and maintain the portion of the conveyance system within an individual’s responsibility.
- **Homeowner Maintenance Responsibility**: This criterion is based on the amount of responsibility for the homeowner to maintain the system within their property.

Criteria identified for the treatment option matrix were as follows:

- **Range of Flows**: It is anticipated that there will be a large variance in flows due to seasonal and weekend visitors. The wastewater treatment system’s ability to handle the flow variability and maintain a stable treatment process is an important consideration. Additionally it is expected that the Summerhaven population will increase as homes are rebuilt, so this criteria attempts to quantify this factor.
- **Quality of Effluent for Intended Use**: Because of the environmentally sensitive nature of the area and the anticipation of more stringent regulations, effluent quality is a key factor in the selection process.
- **Footprint and Overall Size**: Due to the limited amount of space Pima County has at its current facility, overall plant size and how it can be incorporated with the current facility is a key factor.
- **Capital Costs**: This criterion is based on the cost for the construction and installation of the new treatment system in 2007 dollars.
- **Operation & Maintenance Costs**: This criterion is based on the present worth cost of maintaining and operating the treatment system.
- **Constructability**: This criterion is based on the ease or complexity of installing the new treatment system.
- **Operability**: This criterion is based on the ease or complexity required to control and keep the plant in operation and compliance during all operating conditions.
- **Solids Handling**: This criterion is based on the quality and quantity of solids generated during the biological treatment process.
- **Community Acceptance**: This criterion is based on nuisance odors and noise generated and on the physical appearance of the treatment plant.
Once the above mentioned criteria were selected a relative weight was assigned to each criterion, based on how important each of the criteria is to PCWMD. A discussion session between the team members established the weight of each criterion. Each criterion was ranked on a scale from 1 to 5, with 5 being the most important and 1 being the least important. Once there was a consensus for the list of criteria and their weights, each treatment and conveyance technology option was evaluated.

In order to evaluate each new treatment and conveyance technology a baseline was established. The baseline is one of the possible alternatives that may be chosen in the selection matrix and each alternative was compared against the baseline. A raw score was assigned to each of the criteria then the weighted score was established by multiplying the raw score by the weight of each criterion. The baseline option was assigned a raw score of 3 which represents a neutral score. Options with a raw score lower than 3 were considered less desirable than the baseline, a raw score greater than 3 meant it was more desirable than the baseline, and a raw score of 3 meant that the option was as considered equally desirable as the baseline.

The baseline chosen for the conveyance system matrix is a traditional gravity sewer system. This is an appropriate option with which to compare all other options, because it exists throughout PCWMD’s conveyance system and it is the most common technology used.

The baseline chosen for the treatment options is the current treatment plant with required upgrades to be in compliance with probable future regulations and restrictions.

The outcome of the final selection matrices can be found in Table 5-1 and Table 5-2.
## Table 5-1 Selection Matrix For Treatment Options

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Weight</th>
<th>Existing Plant w/ Improvements</th>
<th>SBR w/ Filter</th>
<th>MBR</th>
<th>EA from Marana</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Raw Score</td>
<td>Weighted Score</td>
<td>Raw Score</td>
<td>Weighted Score</td>
</tr>
<tr>
<td>Range of Flows</td>
<td>5</td>
<td>3</td>
<td>15</td>
<td>6</td>
<td>30</td>
</tr>
<tr>
<td>Quality of Effluent for intended use</td>
<td>3</td>
<td>3</td>
<td>9</td>
<td>5</td>
<td>15</td>
</tr>
<tr>
<td>Footprint Overall Size</td>
<td>4</td>
<td>3</td>
<td>12</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Capital Cost</td>
<td>3</td>
<td>3</td>
<td>9</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>O &amp; M Costs</td>
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<td>3</td>
<td>12</td>
<td>6</td>
<td>24</td>
</tr>
<tr>
<td>Constructability</td>
<td>4</td>
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<td>12</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Operability/ Reliability</td>
<td>5</td>
<td>3</td>
<td>15</td>
<td>6</td>
<td>30</td>
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<tr>
<td>Solids Handling</td>
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<td>6</td>
<td>24</td>
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<tr>
<td>Community Acceptance</td>
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<td>3</td>
<td>12</td>
<td>4</td>
<td>16</td>
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<tr>
<td>Total Rating</td>
<td></td>
<td>108</td>
<td>150</td>
<td>127</td>
<td>130</td>
</tr>
</tbody>
</table>

Score:  
- Better: 6  
- 5  
- 4  
- Neutral: 3  
- 2  
- Worse: 1  
- 0
<table>
<thead>
<tr>
<th>Criterion</th>
<th>Weight</th>
<th>Raw Score</th>
<th>Weighted Score</th>
<th>Raw Score</th>
<th>Weighted Score</th>
<th>Raw Score</th>
<th>Weighted Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>O &amp; M Costs</td>
<td>4</td>
<td>3</td>
<td>12</td>
<td>5</td>
<td>20</td>
<td>4</td>
<td>16</td>
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<td>3</td>
<td>9</td>
<td>5</td>
<td>15</td>
<td>5</td>
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<td><strong>Total Rating</strong></td>
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<td><strong>87</strong></td>
<td><strong>130</strong></td>
<td><strong>118</strong></td>
<td><strong>118</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Score:
- Better 5
- Neutral 4
- Worse 3
- Better 2
- Worse 1
5.1 **Conveyance Technologies**

The existing collection system was constructed between June 1982 and May 1984. According to the as-built drawings, it consists of approximately 2,400 linear feet of 8-inch diameter ductile iron pipe (DIP), 11 house connections (HCS), and 17 manholes. The existing alignment is located mainly within the paved area of Sabino Canyon Park road. Using Manning’s Equation assuming a full pipe, a Manning’s coefficient of 0.013, and the minimum slope of 0.40%, for an 8-inch line, the capacity of the conveyance system was calculated to be capable of conveying approximately 495,000 gallons per day. This should be more than sufficient to convey the ADF and peak flows for the first 50,000 gpd plant expansion and 20 year flow projections based on observed trends.

Due to the many challenges resulting from the terrain, alternative conveyance technologies may need to be installed in order to expand the number of house connections serving the Mount Lemmon community.

There are many wastewater conveyance technologies available on the market today. The ability to safely and efficiently transport the wastewater from the source to the treatment facility is one of the main focuses of this section. Three different technologies have been identified, Traditional Gravity, Septic Tank Effluent Pumping/Septic Tank Effluent Gravity (STEP/STEG) systems, and Low Pressure Sewer systems.

### 5.1.1 **Traditional Gravity Sewer**

A traditional gravity sewer system is the most widely used method for wastewater conveyance. This type of system is generally comprised of 8-inch diameter and larger sewer lines, with sewer manholes spaced every 500 feet. This system relies on gravity to convey the wastewater to the treatment plant and typically is the easiest to maintain. However, due to the unique characteristics of the Mt. Lemmon community this system has some drawbacks.
**O&M Costs:** The Summerhaven topography is problematic for the operation and maintenance of a traditional gravity sewer system. Pima County’s Vactor maintenance vehicles have high centers of gravity and can only negotiate a 10% grade, maximum. The terrain in Summerhaven would pose a challenge for maintaining the sewers using these vehicles. Thus smaller less efficient vehicles would need to be used. Better maintenance roads would have to be constructed in order for a gravity sewer to be cost effective for Pima County.

**Capital Costs:** It is estimated that the capital costs for a traditional gravity sewer system in Summerhaven would be within the range of **$300 to $600** per linear foot of sewer line installed. A more detailed breakdown of these costs can be found in Table 5-3. Items that were included in the capital cost of the traditional gravity sewer system are as follows:

- Cost per linear foot for 8-inch DIP pipeline installed in place.
- Cost per cubic yard of excavation which includes drilling and blasting, or mechanical removal means such as a rock saw.
- Cost per manhole which includes excavation by drilling and blasting or mechanical removal means such as a rock saw, and special coatings.
- Mobilization and demobilization of equipment and materials.

The major costs for the new infrastructure that can be anticipated are the cost of excavation and the mobilization and demobilization of equipment up and down the mountain. This is due to the fact that the anticipated trench width will be a minimum of 24” wide by 4-foot deep and the excavation for each manhole will need to be at approximately 8 feet in diameter. Construction equipment accessibility required to excavate the trench and install the manholes may also be a limiting factor and could significantly increase the costs.
### Table 5-3 TRADITIONAL GRAVITY SYSTEM

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<th>Item</th>
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<td># Mobilization and Demobilization</td>
<td>LS</td>
<td>1</td>
<td>$100,000</td>
<td>$100,000</td>
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<tr>
<td>2 8&quot; Ductil Iron Pipe</td>
<td>LF</td>
<td>8000</td>
<td>$75</td>
<td>$600,000</td>
</tr>
<tr>
<td>3 Rock Excavation</td>
<td>CY</td>
<td>2400</td>
<td>$115</td>
<td>$276,000</td>
</tr>
<tr>
<td>4 New Manhole</td>
<td>EA</td>
<td>25</td>
<td>$60,000</td>
<td>$1,500,000</td>
</tr>
<tr>
<td>SUBTOTAL</td>
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<td></td>
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<td>$2,476,000</td>
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<tr>
<td>30% Contingency</td>
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<td>TOTAL</td>
<td></td>
<td></td>
<td></td>
<td>$3,218,800</td>
</tr>
</tbody>
</table>

COST PER LINEAR FOOT                        | $402    |
MOST PROBABLE COST RANGE - 30% TO +50% PER LF | $282 TO $604 |

1. To include drilling and blasting or removal by mechanical means such as a rock saw.
2. Assumes a 2' wide trench 4' deep
3. Includes Bedding and Backfill.
4. Assumes 1 manhole every 500 feet with 5 additional manholes for alignment adjustments
Rehabilitation and Replacement: Again sewer access poses a problem with gravity sewers. Many of the access roads throughout the community are located on private property, therefore impacts to property owners may be significant if the system needs to be replaced or repaired.

Constructability: Constructability of a traditional gravity sewer system on Mt. Lemmon is expected to be problematic due to the topography of the area. Many of the easements and rights-of-way do not have access roads. In addition access to some locations would require contractors to travel through private property in order to install the sewer system. During construction residents may be severely inconvenienced. It is very likely that during construction access to certain properties would be blocked due to the narrow access roads on the mountain; the further up the mountain - the more difficult the sewer construction would be.

Individual Property Cost: Individual property costs depend on the location of each of the property owners. If a property fronts a Pima County installed sewer system then the costs to the owner would be connection fees and the cost to construct an HCS to the sewer system. However, if a property does not front a Pima County installed sewer system then cost would be more significant. The installation of new manholes and sewer lines would be equivalent to the capital costs mentioned above.

Homeowner Maintenance Responsibility: The homeowner’s maintenance responsibilities for the Traditional Gravity System are what are typically required for a standard HCS. There is little to no action required for the homeowner to maintain the system within their property unless there is a blockage or accidental break.

5.1.2 Step/Steg System
STEP stands for Septic Tank Effluent Pumping and STEG stands for Septic Tank Effluent Gravity system. Under this conveyance scenario, most of Mt. Lemmon would utilize a STEG system because the existing conveyance sewer system is located down Sabino Canyon Park Road which is the lowest point in the community. This system has many advantages over the Traditional Gravity
system, however since it is a nontraditional means for conveyance it also poses a few problems of its own.

The typical STEP/STEG infrastructure requires each resident having an appropriately sized septic tank on their property. The effluent from the septic tanks would then be conveyed by smaller diameter pipelines to the treatment facility or central gravity conveyance system. It is anticipated that the largest pipe required for this system would be 4-inch diameter with cleanouts instead of manholes. Some advantages of this conveyance system are lower construction costs, the system can be maintained using smaller equipment, and the conveyance system is more accessible. In addition, there is a significant reduction in solids entering the treatment plant.

One disadvantage of this type of a system is that the individual septic tanks would need to be maintained on a regular maintenance schedule to prevent solids from entering the conveyance system. Currently homeowners that have septic tanks are responsible for their own maintenance (pumping, inspections, etc.). However on Mt. Lemmon it may be in the County’s best interest to pass an ordinance requiring routine maintenance on the septic systems to protect the smaller diameter conveyance system.

Another disadvantage to this type of system is there may be several permitting hurdles to overcome and the Arizona Department of Environmental Quality may not allow such a system to exist without demonstrating its effectiveness. There are no rules currently addressing the use of septic tank effluent being conveyed in small diameter pipelines. It is also possible that if these systems do not exactly match the Type 4.0 general permit requirements that individual Aquifer Protection Permits may be required by ADEQ.

Currently, Pima County does not have the necessary equipment for maintaining small diameter pipes. This equipment would either need to be purchased and staged at the Mt. Lemmon Wastewater Treatment Facility or contractors would need to have on-call contracts for pipeline maintenance. The cut sheets for the ProStep conveyance system can be found in Appendix N.

**O&M Costs:** The topography is not as problematic for a STEP/STEG system. The system can be maintained using smaller maintenance vehicles utilizing
standard plumbing equipment and supplies. If the septic tanks throughout the system are properly sized and maintained there would be very little solids entering the conveyance system. Root intrusion and other typical blockages are generally resolved through the use of cable powered cutting machines.

**Capital Costs:** It is estimated that the capital costs for the STEP/STEG conveyance system would be approximately **$40 to $90** per linear foot of sewer line installed. A more detailed breakdown of these costs can be found in Table 5-4. Items that were included in the capital cost of the STEP/STEG sewer system are as follows:

- Cost per linear foot for 4-inch DIP pipeline installed in place.
- Cost per cubic yard of excavation which includes rock excavation using mechanical means such as a rock saw.
- Mobilization and demobilization of equipment and materials.

The only significant cost that can be identified for the installation of this system would be the cost for excavation in the bedrock. However, this is not as extensive as the installation of 8-inch sewers and manholes. Because of the small pipe size, each pipeline can be installed in an 8-inch wide trench using a rock saw trencher.

**Rehabilitation and Replacement:** Accessibility to the sewer infrastructure does not pose as much of a problem as a Traditional Gravity system does. Because the STEP/STEG system can be maintained utilizing smaller equipment and standard plumbing supplies there would not be as much impact to residents.

**Constructability:** Constructability of a STEP/STEG system is not as problematic as the traditional gravity sewer conveyance system as well. Because there are no 4-foot diameter manholes to install, the system can be installed using smaller more maneuverable equipment. The impact to many of the residents is not as problematic as well. Because of the smaller equipment used to install the pipelines construction access to certain properties could be more easily obtained on the mountain.
Table 5-4 STEG or Low Pressure System^5

<table>
<thead>
<tr>
<th>Item #</th>
<th>Installed in Place</th>
<th>Unit</th>
<th>Quantity</th>
<th>Unit Price</th>
<th>Total</th>
</tr>
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<td>1</td>
<td>Mobilization and Demobilization</td>
<td>LS</td>
<td>1</td>
<td>$50,000</td>
<td>$50,000</td>
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<tr>
<td>1</td>
<td>4&quot; Ductile Iron Pipe^3</td>
<td>LF</td>
<td>8000</td>
<td>$35</td>
<td>$280,000</td>
</tr>
<tr>
<td>2</td>
<td>Rock Excavation^1,2</td>
<td>CY</td>
<td>800</td>
<td>$115</td>
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<td>3</td>
<td>New Manhole^4</td>
<td>EA</td>
<td>0</td>
<td>$60,000</td>
<td>$0</td>
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</tbody>
</table>

SUBTOTAL 30% Contingency: $372,000
TOTAL: $483,600

COST PER LINEAR FOOT: $60

MOST PROBABLE COST RANGE - 30% TO +50%: $42 TO $91 Per Linear Foot Costs

1. To include drilling and blasting or removal by mechanical means such as a rock saw.
2. Assumes a 8" wide trench 4’ deep
3. Includes Bedding and Backfill.
4. Assumes no manholes will be installed in system.
Individual Property Cost: For those properties that do not front PCWMD’s conveyance system in order to connect to the conveyance system the installation cost would be equivalent to the capital costs mentioned above. In addition, the property owner would need to have a septic tank installed on their property and a regular maintenance schedule would have to be established in order to protect the conveyance system from clogging. There will be connection fees and impact fees paid to Pima County for individual connections. However, with all of the above mentioned costs this option is significantly less expensive to the individual property owners than having to install a Traditional Gravity system.

Homeowner Maintenance Responsibility: The homeowner’s maintenance responsibility is similar to those who own homes with a septic tank and leach field. However, due to the fact that the actions of the individual homeowner can impact other homeowners connected to the conveyance system a mandated maintenance schedule may be required.

5.1.3 Low Pressure System
A Low Pressure system is essentially the same conveyance system as a STEP/STEG system with one very important distinction. It utilizes individual grinder pump stations at each lot instead of septic tanks. This type of a system has the same advantages as the STEP/STEG system, such as the use of smaller diameter pipelines and constructability, and capital cost would be very similar. However there are some disadvantages to such a system as well.

Due to the topography of the mountain community a mostly gravity Low Pressure system would be the most beneficial. This is due to the large elevation differences which would make a pressurized system significantly higher in pressure than desired at the discharge points into Pima County’s existing conveyance system. Thus the new infrastructure would be made up of primarily 4-inch ductile iron pipe with clean outs similar to the STEP/STEG system.

Some disadvantages to this system would be that there is no reduction of solids conveyed to the treatment plant, odor problems may become an issue, and there is some degree of complexity added to the homeowner’s system. In addition if a grinder pump station fails it could directly impact the environment if there were a sanitary sewer overflow resulting from the failure. Therefore the system may
require backup systems that would prevent such a negative impact. This could include shutting off the water supply to the home, emergency alarms which would send a signal to an off site operator and possibly redundant pumps in each pump system.

Another disadvantage to this type of system is there may be several permitting hurdles to overcome and the Arizona Department of Environmental Quality may not allow such a system to exist without demonstrating its effectiveness. There are no rules currently addressing the use of small diameter pipelines conveying wastewater by gravity to the existing conveyance system. It is also possible that if these systems do not exactly match the Type 4.0 general permit requirements (and they appear not to) that individual Aquifer Protection Permits may be required by ADEQ.

Some of the advantages this system has which neither the STEP/STEG nor the Traditional Gravity systems have are the flow pacing and retention capabilities of the Low Pressure system. Each grinder pump station acts as an individual retention basin. The pump stations can be programmed to only pump at certain flow rates and can also be programmed to pump during certain time periods. This has many advantages for controlling hydraulic peaks and equalizing loading at the treatment plant. The cut sheets for the E/one low pressure sewer conveyance system can be found in Appendix O.

**O&M Costs:** Operation and Maintenance is not as problematic for a Low Pressure system as it is for the Traditional Gravity system. The system can be maintained using smaller maintenance vehicles utilizing standard plumbing equipment and supplies. Root intrusion could be problem but a cable powered drain cleaning equipment can be used to maintain the piping. There may be additional Operation and Maintenance costs due to the fact that there will be no solids reduction in the system thus the cost for maintaining a Low Pressure system may be slightly higher than a STEP/STEG system.

**Capital Costs:** It is estimated that the capital costs for a Low Pressure system would be within the range of $40 to $90 per linear foot of sewer line installed. A more detailed breakdown of these costs can be found in Table 5-4. Items that
were included in the capital cost of the Low Pressure sewer system are as follows:

- Cost per linear foot for 4-inch DIP pipeline installed in place.
- Cost per cubic yard of excavation which includes rock excavation using mechanical means such as a rock saw.
- Mobilization and demobilization of equipment and materials.

The only significant cost that can be identified for the installation of this system would be the cost for excavation in the bedrock. However, this would not be as expensive as the installation of 8-inch sewers and associated manholes. Because of the pipe diameter each pipeline can be installed in an 8-inch wide trench using a rock saw trencher.

**Rehabilitation and Replacement:** Accessibility to the sewer infrastructure does not pose as much of a problem as a Traditional Gravity system does. Because the Low Pressure system can be maintained utilizing smaller equipment and standard plumbing supplies, there is not as much impact to the residents as well.

**Constructability:** Constructability of a Low Pressure system is not as problematic as the traditional gravity sewer conveyance system. Because there are no 4-foot diameter manholes to install, the system can be installed using smaller more maneuverable equipment. The impact to residents is not as problematic as well. Because of the smaller equipment used to install the pipelines construction access to certain properties could be more easily obtained on the mountain.

**Individual Property Cost:** For those properties that do not front Pima County’s conveyance system in order to connect to the conveyance system the installation cost would be equivalent to the capital costs mentioned above. In addition the property owner would have to have a grinder pump station installed on their property and a maintenance contract with the pump station provider would have to be maintained throughout the life of the pump station. In addition there will be connection fees and impact fees paid to Pima County as well. However, with all of the above mentioned costs this option is significantly less expensive for the individual property owners than having to install a Traditional Gravity system.
Homeowner Maintenance Responsibility: The homeowner maintenance responsibility does not impact other homeowner’s throughout the system so a mandated maintenance schedule may not be required. However, if a grinder pump station fails it could directly impact the environment if there were a sanitary sewer overflow resulting from the failure. Therefore the system would require backup systems that would prevent such a negative impact. This could include shutting off the water supply to the home, emergency alarms which would send a signal to an off site operator and possibly redundant pumps in each pump system.

5.1.4 Conveyance System Conclusion & Recommendations
Because of the topography and the limited accessibility for the construction and maintenance of any potential conveyance system a traditional gravity system with manholes would be problematic. In addition to the existing infrastructure two additional locations have been identified for future maintenance and possible construction by Pima County. These locations are along Carter Canyon Road and Turkey Run Road. All other locations has been deemed infeasible for Pima County to maintain. This means that the two remaining system segments discussed above must be constructed and maintained by a private improvement district. Figure 5-1, Potential Sewer Conveyance System, demonstrates examples of new infrastructure for both Pima County maintained and privately maintained sewers.

Comparing the remaining systems, a STEP/STEG system and the Low Pressure system have many characteristics that make them both likely candidates for the conveyance system. They both have relatively the same capital costs for installation; they both can be readily accessed and maintained; and they both are more easily constructible than a traditional gravity system. However, there are a few items that make the STEP/STEG system more desirable than the Low Pressure system.
It is anticipated that the operation and maintenance for the Low Pressure sewer system would cost slightly more than the STEP/STEG system. This is because the Low Pressure system does not remove any solids from the conveyance system; it merely grinds the solids up. Because, the conveyance system would be made up of mainly four-inch diameter lines and no manholes, it may be in the County’s best interest to avoid solids from accumulating within the pipelines. Another disadvantage the Low Pressure sewer system has over the STEP/STEG system is the level of complexity and responsibility the individual home owner has to operate and maintain the system. Most of the community can be served by gravity thus there would be little need for pump stations. Therefore a STEG system would be no more difficult to maintain than a septic tank and leach field system. Homeowner maintenance of a Low Pressure lift station could cost significantly more over the system life cycle than the STEG system. Thus a STEG system for the conveyance system would be the most desirable system to install and maintain. The results of the selection process can be identified in the final Selection Matrix for Conveyance System found in Table 5-1.

Even though the STEG system has been identified as a feasible option for the conveyance expansion for the Summerhaven community, it is understood that the system’s infrastructure network and pipe sizes must be engineered at the time of the design. Permitting issues may also make this approach less than desirable.

5.2 Treatment Technologies
There are many treatment technologies on the market today that can safely and effectively treat municipal wastewater; however this report focuses only on small prepackaged plants that can be prefabricated and delivered to the site on a truck and can fit on the small land available at the current property. Prepackaged plants are fast, easy to construct and are typically well known and accepted by various reviewing agencies throughout the country.
The treatment options identified in this section of the report are: upgrading the current plant, replacing the current plant with one of the following packaged plants - a sequencing batch reactor (SBR) and filtration, a membrane bioreactor (MBR), or an extended aeration (EA) wastewater treatment plant transferred from the Marana treatment plant. Because the Mount Lemmon community is a small isolated mountaintop community, there were some assumptions made for selecting the most viable option for the community. The assumptions made were as follows:

- Various effluent disposal restrictions would be lifted; this includes legal, environmental, and/or permit restrictions.
- The existing lot would be able to accommodate additional treatment expansions.
- The new treatment option would be able to accommodate future treatment regulations.
- Zinc and copper removal could be handled at the source. If this assumption is incorrect then plant improvements for zinc and copper removal would need to take precedence over treatment capacity expansions.
- Noise, odor, and aesthetic control setback issues can be resolved.
- The effluent would be disinfected using an ultraviolet (UV) system.

For comparison proposes it is presumed that all of the above mentioned assumptions are true. Thus the four different treatment schemes have been outlined and compared utilizing those assumptions.

### 5.2.1 Upgrading the Current Plant with Improvements

The current WWTF is a circular extended aeration plant with an oxidation ditch forming an outer ring and a clarifier in the center. This plant was built in the early 1980s and was one of the few structures in Summerhaven that survived the 2003 Aspen fire. One of the goals for improvements is to manage peak demands through off-site flow equalization and to improve the quality of treated effluent to increase beneficial use/reclaimed use options.

One of the long-term goals for treatment improvements would be to increase the treatment capacity; however because of the effluent disposal restrictions on the plant in permits, the first step is to improve effluent quality and remain within
permitted flow restrictions then to increase flow limits in permits as needed. Overall, increased flows over time must be coupled with increased disposal options (see disposal option section). Thus upgrading the plant (including new treatment capacity) to meet future regulations without increasing discharge/flow limitations may be the best short term option for the Mount Lemmon community while disposal restrictions for discharge to Sabino Creek are addressed. Upgrades to the current plant would need to meet new facility BADCT treatment performance standards and include but are not limited to denitrification, filtration, and disinfection. Additional treatment is also likely to be needed for reducing copper and zinc concentrations in treated effluent to increase disposal options and provide greater receptivity to revising rule to remove the prohibition to discharge to Sabino Creek. This can be accomplished by converting the existing plant into a modified Ludzack-Ettinger (MLE) process and by adding a sand filter with denitrification abilities. In addition, an ultraviolet disinfection (UV) system would also be installed. The items necessary to convert the plant into an MLE process is an anoxic tank ahead of the plant with an internal recycle loop. In addition it is recommended that the influent into the facility be fully characterized and the process be modeled (with additional associated costs) in order to fully optimize the process prior to design implementation. A simple process diagram can be found in Figure 5-2, Current Plant with Improvements Process Diagram.

**Range of Flows:** The current plant has limited ability to treat a wide range of flows and often has difficulty keeping the biological process working during low flow periods due to the lack of substrate entering the plant. The capacity of this plant is currently permitted to have a monthly average flow of 12,500 gpd and a single-day maximum of 17,000 gpd. However, the actual rated capacity of the treatment plant is 15,000 gpd.
Quality of Effluent for Intended Use: Because of the environmentally sensitive nature of the area and the anticipation of more stringent regulations, effluent quality is a key factor for the community. The current plant is currently producing a Class B reclaimed water. This is due to the fact that the current plant does not have the capability for denitrification, filtration, and disinfection. In order for the plant to meet the requirements of more stringent regulations denitrification, filtration, and disinfection processes would have to be added to the system. There are two different processes that have been identified to accomplish denitrification of the current facility. Converting the facility into a MLE process and the addition of a sand filter with denitrification capabilities. Based on available data it has been determined that the average total nitrogen entering the plant is 110 mg/l which is very high for a typical municipal wastewater treatment plant. Thus it is recommended that converting the plant into an MLE process and adding a sand filter with denitrification capabilities is necessary to accomplish the desired nitrogen levels. In addition to denitrification, a UV system would be necessary for disinfection and THM reduction. Information on the influent quality of the current plant can be found on Appendix G Vendor information for the UV system and the sand filter is located in Appendix P.

Footprint and Overall Size: Utilizing the current plant and adding an anoxic tank, sand filter, and UV system would have a significantly smaller footprint than a SBR or MBR expansion because the treatment capacity will remain unchanged. Thus the only requirements would be the space needed for an anoxic tank, sand filter, and a UV system. A preliminary concept site plan can be seen in Figure 5-3, Current Plant with Improvements Site Plan.
Mt. Lemmon Service Area Watershed Study & Wastewater Management Plan (Project No. 206145)

Figure 5-3

PIMA COUNTY
WASTEWATER MANAGEMENT
DEPARTMENT

MT. LEMMON
CURRENT PLANT WITH IMPROVEMENTS
CONCEPT SITE PLAN

SCALE 1"=40'

CONTOUR INTERVAL 2'

E E E E
Engineering and Environmental Consultants, Inc.
4685 E. FT. LOWELL RD.
HUDSON, ARIZONA 85712 520-321-4685

DESIGN
DRAWN
CHECKED
DATE
SCALE

PIMA COUNTY
WASTEWATER MANAGEMENT
DEPARTMENT
200 North Stone Avenue • Tucson, Arizona 85701-1207 • Phone: (520) 790-5580

09/28/07

230
Capital Cost: The capital cost for the addition of a sand filter with denitrification abilities and a UV system for disinfection would have significantly lower capital costs than the expansion of the plant with a SBR or MBR. This is because this option would not increase the treatment capacity of the plant. It is estimated that the capital costs for improving the current treatment plant with a sand filter and UV system would be within the range of $0.7 Million to $1.5 Million. A more detailed breakdown of these costs can be found in Table 5-5.

Operations and Maintenance Costs: The operation and maintenance cost for the current plant would be more than it is now. This is because of the added complexity of adding an anoxic tank with an internal recycle, sand filter, and UV system to the system. In addition, the cost for operating the current plant with improvements may in fact be the most expensive option with regards to manpower for operating the plant and power consumption. See Section 4.5 for additional discussion on operation and maintenance costs.

Constructability: It is anticipated that the new improvements would be constructed above grade thus there would be few constructability issues other than mobilizing the equipment and materials up the mountain.

Operability / Reliability: The current plant is currently over 20 years old. There are currently no means for rehabilitation of the current oxidation ditch which is made of steel. There is not enough redundancy built into the system to maintain the structures and there is not sufficient storage for emergency overflow or bypass. As this plant ages it becomes more and more difficult to maintain. Eventually it will need to be replaced but this would require the construction of a new system. An interim solution that would provide some redundancy to the system would be to install an offsite effluent storage tank that would function as a means of pacing the discharge so that it does not exceed the permitted discharge limits.
Currently the plant has been operating reliably. It is consistently producing Class B reclaimed water. With the addition of an anoxic tank, a sand filter and UV system it is unknown how reliable such a system will be. This is due to the fact that there is no inorganic solids removal ahead of the plant. This has the potential for the sand filter to operate inefficiently unless a grit removal system is installed ahead of the plant.

**Solids Handling:** Traditionally the sludge production of a properly operated Extended Aeration plant such as the current Mount Lemmon Plant is higher than an SBR and about 30-40% higher than an MBR. In addition as mentioned before there is no inorganic solids removal ahead of the plant.

**Community Acceptance:** The workshop held on February 10, 2007 resulted in public participation for the preparation of this report. Two of the public and stakeholder goals identified during that workshop are to increase the treatment capacity of the plant to meet the demand for redevelopment, and to improve the quality of effluent to increase reclamation options. This option would improve the quality of effluent but would not increase the treatment capacity of the plant. Without additional capacity any existing residents with failing septic systems would not be permitted to connect to the conveyance system.
### TABLE 5-5 CURRENT PLANT WITH IMPROVEMENTS

#### PROBABLE CONSTRUCTION COST RANGE

<table>
<thead>
<tr>
<th>Item #</th>
<th>Installed in Place</th>
<th>Unit</th>
<th>Quantity</th>
<th>Unit Price</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mobilization and Demobilization</td>
<td>LS</td>
<td>1</td>
<td>$100,000</td>
<td>$100,000</td>
</tr>
<tr>
<td>2</td>
<td>Anoxic Tank</td>
<td>LS</td>
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<td>3</td>
<td>Filtration System</td>
<td>LS</td>
<td>1</td>
<td>$300,000</td>
<td>$300,000</td>
</tr>
<tr>
<td>4</td>
<td>Ultra Violet Disinfection</td>
<td>LS</td>
<td>1</td>
<td>$70,000</td>
<td>$70,000</td>
</tr>
<tr>
<td>5</td>
<td>Yard Piping</td>
<td>LS</td>
<td>1</td>
<td>$60,000</td>
<td>$60,000</td>
</tr>
<tr>
<td>7</td>
<td>Effluent Pump Station</td>
<td>LS</td>
<td>1</td>
<td>$250,000</td>
<td>$250,000</td>
</tr>
</tbody>
</table>

**SUBTOTAL**<br>30% Contingency<br>**TOTAL** $1,092,000

**PROBABLE COST RANGE**<br>−30% TO +50% $764,400 TO $1,638,000

---

1. This is an example used for planning purposes only and is hypothetical in nature. Actual costs depend on the design on the treatment system.
2. Assumes the use of a Gravity Sand Filter with denitrofication capabilities
3. Assumes the installation of an UV channel
4. Assumes Effluent Pump Station can be used for Flow Equalization.
5.2.2 Sequencing Batch Reactor with Filtration (SBR)

A Sequencing Batch Reactor (SBR) essentially treats the wastewater in batches. There are several advantages an SBR has over continuous flow processes. First, the batch mode allows flexibility in the biological processing. This flexibility helps deal with a wide range of flows coming into the plant. Second, the ability to sequentially feed reactors provides an environment that naturally selects non-filamentous bacteria. Finally, in a batch reactor, the final clarification step occurs in a quiescent zone with no inflow. A simple process flow diagram for an SBR system can be found in Figure 5-4, SBR Plant Upgrade/Replacement Process Flow Diagram.

The SBR system that was analyzed for this report was the Fluidyne ISAM SBR system. It consists of three distinct chambers: an anaerobic chamber, an anoxic chamber, and an aerobic chamber. The system is extremely simple in its design, and is available for average influent flows from 5,000 gpd to 100,000 gpd. The Fluidyne brochure can be found in Appendix Q.

*Range of Flows:* An SBR has the capability of handling a wide range of flows because it can treat the wastewater in smaller batches during low flows. This capability enables an SBR to handle a wide range of flows from weekend peaks to seasonal low flow periods.

*Quality of Effluent for Intended Use:* It can be expected that the effluent quality of an SBR with filtration and UV disinfection can achieve a Class A+ reclaimed water quality. The expected results provided by an SBR vendor can be found in Appendix R.
Mt. Lemmon Service Area Watershed Study & Wastewater Management Plan (Project No. 206145)

PIMA COUNTY WASTEWATER MANAGEMENT DEPARTMENT
261 North Stone Avenue * Tucson, Arizona 85701-1207 * Phone: (520) 740-6360

ENGINEERING AND ENVIRONMENTAL CONSULTANTS, INC.
4625 E. PT. LOWELL RD. TUCSON, ARIZONA 85712 520–321–4625

SEQUENCING BATCH REACTOR

BACKWASH

INFLUENT PUMP STATION

GRT REMOVAL

EQUALIZATION TANK

PUMP

INFLUENT

SEWAGE HANDLING PROCESS

OFF SITE SLUDGE

SAND FILTER WITH DETRITIFICATION PROPERTIES

AEROBIC/CLARIFIER CHAMBER

PUMP

SERVICE WATER

TO AN ALTERNATIVE DISPOSAL OR REUSE SYSTEM

EFFLUENT PUMP STATION

UV DISINFECTION

FIGURE 5-4
**Footprint and Overall Size:** One of the most significant restrictions for an SBR plant expansion is the existing lot. Per Title 18 Part B of the Arizona Administrative Code, any significant treatment expansion would need to follow the Best Available Demonstrated Control Technology (BADCT).

Under BADCT the set back requirements would be the most significant drawback for a plant expansion. Figure 5-5, SBR Site Plan (Plant Expansion) demonstrates what a potential site plan for an SBR plant expansion could look like. The most significant lot restrictions would be the 100-yr flood plain to the south of the lot and the set back requirements to the north and west of the lot. In addition, because of BADCT the new treatment process would need to be placed inside a building in order to have full noise, odor and aesthetic controls.

**Capital Cost:** The capital cost for an SBR with filtration and a UV system for disinfection would have significantly higher capital costs than the current plant with improvements. This is because this option would increase the treatment capacity of the plant site significantly and to meet APP requirements, would be placed inside a building in order to have full noise, odor, and aesthetic controls to reduce setback requirements to 50 feet or less. In addition because of the floodplain to the south and potential setback issues to the north, hydrologic studies and designs including additional flood protection would be needed. It is estimated that the capital costs for an SBR treatment plant would be within the range of **$2.4 million to $5.1 million.** A more detailed breakdown of these costs can be found in Table 5-6.
**Operations and Maintenance Costs:** In relative terms the SBR system evaluated for this report appears to be an economical solution when it comes to power consumption due to the fact that most of the aeration comes from a submersible pump and not from blowers. In addition it is not anticipated that chemical injection into the plant is required thus reducing chemical usage. See Section 4.5 for additional discussion on operation and maintenance costs.

**Constructability:** It is anticipated that the new improvements would be constructed above grade thus there would be little need for excavation other than foundations. However, due to the floodplain to the south and the set back issue to the north additional flood protection of the plant maybe required.

**Operability / Reliability:** Historically SBRs have been cumbersome to maintain and operate because of the need to make adjustments as the flow characteristics of the influent changed. However, with the latest technology for controls and motoring systems this type of system can be very reliable and operator friendly. In addition, SBR technology has been a proven technology for more than 20 years.

**Solids Handling:** A traditional SBR would produce slightly less sludge than an Extended Aeration plant, however the system analyzed for this report contains an anaerobic chamber up front and the manufacture claims that the sludge volume can be reduced up to 75%. There is still the issue of inorganic solids which cannot be reduced by the biological process. This problem can be overcome by having inorganic solids removal ahead of the new plant. One possible solution would be to utilize the current plant for flow equalization and solids removal.

**Community Acceptance:** The immediate goal of increasing the treatment capacity would be met by the SBR system. However, an SBR plant would require blowers which may create some potential noise issues, and because of the anaerobic chamber of the Fluidyne system there are some potential odor issues as well.
Sound dampeners and air scrubbers would need to be added to the process and thus would add cost to the plant.
### TABLE 5-6 SBR TREATMENT SYSTEM

#### PROBABLE CONSTRUCTION COST RANGE

<table>
<thead>
<tr>
<th>Item #</th>
<th>Installed in Place</th>
<th>Unit</th>
<th>Quantity</th>
<th>Unit Price</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mobilization and Demobilization</td>
<td>LS</td>
<td>1</td>
<td>$150,000</td>
<td>$150,000</td>
</tr>
<tr>
<td>2</td>
<td>Site Earthwork 2</td>
<td>LS</td>
<td>1</td>
<td>$217,000</td>
<td>$217,000</td>
</tr>
<tr>
<td>3</td>
<td>Filtration System 3</td>
<td>LS</td>
<td>1</td>
<td>$252,000</td>
<td>$252,000</td>
</tr>
<tr>
<td>4</td>
<td>Ultra Violet Disinfection 4</td>
<td>LS</td>
<td>1</td>
<td>$70,000</td>
<td>$70,000</td>
</tr>
<tr>
<td>5</td>
<td>Yard Piping</td>
<td>LS</td>
<td>1</td>
<td>$90,000</td>
<td>$90,000</td>
</tr>
<tr>
<td>6</td>
<td>Influent Pump Station 5</td>
<td>LS</td>
<td>1</td>
<td>$150,000</td>
<td>$150,000</td>
</tr>
<tr>
<td>7</td>
<td>Effluent Pump Station</td>
<td>LS</td>
<td>1</td>
<td>$250,000</td>
<td>$250,000</td>
</tr>
<tr>
<td>8</td>
<td>Building 6</td>
<td>SF</td>
<td>2170</td>
<td>$270</td>
<td>$585,900</td>
</tr>
<tr>
<td>9</td>
<td>Equalization/Grit Mods to Existing Plant</td>
<td>LS</td>
<td>1</td>
<td>$150,000</td>
<td>$150,000</td>
</tr>
<tr>
<td>10</td>
<td>50,000 gpd Package Treatment Plant</td>
<td>LS</td>
<td>1</td>
<td>$713,000</td>
<td>$713,000</td>
</tr>
</tbody>
</table>

**SUBTOTAL**

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$2,627,900</td>
</tr>
<tr>
<td>30% Contingency</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$788,370</td>
</tr>
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<td><strong>TOTAL</strong></td>
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<td></td>
<td><strong>$3,416,270</strong></td>
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</table>

**PROBABLE COST RANGE - 30% TO +50%**

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<table>
<thead>
<tr>
<th></th>
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<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$2,391,389 To $5,124,405</td>
</tr>
</tbody>
</table>

2. To include drilling and blasting or removal by mechanical means such as a rock saw.
3. Assumes the use of a Gravity Sand Filter
4. Assumes the installation of an UV channel
5. Assumes that the existing influent pumpstation can be modified
6. Assumes that the building will be constructed large enough for one 50,000 gpd packaged treatment plant
5.2.3 Membrane Reactor (MBR)
Membrane Bioreactors (MBR) combine conventional biological treatment processes with membrane filtration. In the MBR process, aeration within the aerobic reactor zone provides oxygen for the biological treatment process and maintains solids in suspension. To retain the active biomass in the process, the MBR relies on submerged membranes rather than clarifiers, thus eliminating sludge settling issues. The membranes have porosities ranging from 0.1 to 0.4 microns (depending on the manufacturer), which is considered between micro and ultra filtration. Thus a high quality of effluent can be drawn from the membrane eliminating the sedimentation and filtration processes typically used for wastewater treatment. A simple process diagram for an MBR system can be found in Figure 5-6, MBR Process Flow Diagram. The cut sheets for the Zenon Z-MOD MBR treatment system can be found in Appendix S.

Range of Flows: According to the documentation provided by Zenon, flow equalization would be required for any system with variable flow rates. Because the MBR treatment process does not handle a wide range of flows, an equalization tank must be installed prior to or built into the biological tank.

Quality of Effluent for Intended Use: It can be expected that the effluent quality of an MBR in conjunction with UV disinfection can achieve a Class A+ reclaimed water quality. The expected results provided by the MBR vendor can be found in Appendix T.
Mt. Lemmon Service Area Watershed Study & Wastewater Management Plan (Project No. 206145)
**Footprint and Overall Size:** As stated earlier, the lot on which the new treatment process would be located may be one of the most significant limiting factors for an MBR plant expansion. This treatment process like all other treatment options would have to fall under BADCT. Under BADCT the set back requirements would be the biggest draw back for a plant expansion. Figure 5-7, MBR Plant Site Diagram provides a possible site plan for an MBR plant expansion. Again the biggest lot restrictions would be the 100-yr flood plain to the south of the lot and the set back requirements to the north and west of the lot. In addition because of BADCT the new treatment process would need to be placed inside a building in order to have full noise, odor and aesthetic controls. Given all of these factors the largest plant expansion that would meet all of the requirements would be an MBR that could treat an average daily flow of 100,000 gallons per day.

**Capital Cost:** The capital cost for a MBR and UV disinfection would be the highest cost of all the options considered. This is because this option would increase the treatment capacity of the plant significantly and would be placed inside a building in order to have full noise, odor, aesthetic controls, and would require flow equalization. In addition because of the floodplain to the south and potential set back issues to the north additional flood protection may be required. It is estimated that the capital costs for an MBR treatment plant would be within the range of **$2.5 million to $5.3 million**. A more detailed breakdown of these costs can be found in Table 5-7.

**Operations and Maintenance Costs:** In relative terms it is anticipated that due to the blowers required for aeration and the fact that chemicals are used to clean the membranes this option should have higher energy consumption and chemical costs than both the SBR and the current treatment plant with improvements options. In addition the complexity of this system yields higher replacement costs due to several mechanical control items in the system. See Section 4.5 for additional discussion on operation and maintenance costs.
Mt. Lemmon Service Area Watershed Study & Wastewater Management Plan (Project No. 206145)
Constructability: Just like the SBR it is anticipated that an MBR plant expansion would be constructed above grade thus there would little need for excavation other than foundations. However, due to the floodplain to the south and the setback issue to the north, additional flood protection of the plant may be needed and a hydrologic study needed as the basis of design.

Operability / Reliability: The MBR technology is a relatively new technology which has not proven itself for the long term. Another potential disadvantage is preventing the membranes from fouling. Per information provided by Zenon:

Air scouring and backpulsing are the day-to-day methods used to maintain membrane flux. Over longer periods of time, the membranes can experience fouling caused by accumulation of organic matter or crystallized salts within the membrane fiber pores. On these occasions, the ZeeWeed membranes may require recovery cleaning to restore permeability. The frequency of recovery cleaning is site-specific and directly dependent on influent water characteristics and plant duty cycle.

Typical recovery cleaning frequency is once every six months and includes soaking the membranes overnight in a cleaning solution.

Recovery cleaning is a chemical process that is carried out manually and in-situ using sodium hypochlorite and/or citric acid (as required) stored in closed-topped transportable chemical containers. Sodium hypochlorite is used to oxidize organic foulants and citric acid removes inorganic scaling. The membrane cassette does not have to be removed from the Z-MOD unit in order to perform this cleaning process.

Unlike the current plant with improvements and the SBR with filtration, the MBR process would require onsite chemicals and chemical handling equipment to periodically maintain the membrane filters. Unlike the SBR however Pima County currently has another MBR plant within their jurisdiction which they maintain thus such cleaning procedures may not cause a problem for them.

Solids Handling: Per Zenon:

“Sludge wasting is accomplished by periodically drawing mixed liquor directly from the bioreactor. The frequency of wasting is a
function of influent characteristics, reactor design and operator preference. Typically, mixed liquor wasting may be performed monthly, or over significantly longer periods.”

It is anticipated that there would be significantly less sludge wasted from the MBR process due to the fact that the mixed liquor suspended solids concentration is kept in the range of 10,000 to 15,000 mg/L.

**Community Acceptance:** As with the SBR system the immediate goal of increasing the treatment capacity would be met. In addition it is not anticipated to have many odor issues because it is an aerated plant. However, the MBR plant would require blowers which create some potential noise issues. Sound dampeners would need to be added to the blower system which would add some additional capital cost.
### TABLE 5-7 MBR TREATMENT SYSTEM

#### PROBABLE CONSTRUCTION COST RANGE

<table>
<thead>
<tr>
<th>Item #</th>
<th>Installed in Place</th>
<th>Unit</th>
<th>Quantity</th>
<th>Unit Price</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mobilization and Demobilization</td>
<td>LS</td>
<td>1</td>
<td>$150,000</td>
<td>$150,000</td>
</tr>
<tr>
<td>2</td>
<td>Site Earthwork(^2)</td>
<td>LS</td>
<td>1</td>
<td>$217,000</td>
<td>$217,000</td>
</tr>
<tr>
<td>3</td>
<td>Ultra Violet Disinfection(^4)</td>
<td>LS</td>
<td>1</td>
<td>$70,000</td>
<td>$70,000</td>
</tr>
<tr>
<td>4</td>
<td>Yard Piping</td>
<td>LS</td>
<td>1</td>
<td>$90,000</td>
<td>$90,000</td>
</tr>
<tr>
<td>5</td>
<td>Influent Pump Station(^5)</td>
<td>LS</td>
<td>1</td>
<td>$150,000</td>
<td>$150,000</td>
</tr>
<tr>
<td>6</td>
<td>Effluent Pump Station</td>
<td>LS</td>
<td>1</td>
<td>$250,000</td>
<td>$250,000</td>
</tr>
<tr>
<td>7</td>
<td>Building(^6)</td>
<td>SF</td>
<td>2170</td>
<td>$270</td>
<td>$585,900</td>
</tr>
<tr>
<td></td>
<td>Equalization/Grit Mods to Existing Plant</td>
<td>LS</td>
<td>1</td>
<td>$150,000</td>
<td>$150,000</td>
</tr>
<tr>
<td>9</td>
<td>50,000 gpd Pakage Treatment Plant</td>
<td>LS</td>
<td>1</td>
<td>$1,050,000</td>
<td>$1,050,000</td>
</tr>
</tbody>
</table>

**SUBTOTAL**

| Total   | $2,712,900 |

**30% Contingency**

| $813,870 |

**TOTAL**

| $3,526,770 |

**PROBABLE COST RANGE - 30% TO +50%**

| $2,468,739 TO $5,290,155 |

---

1. This is an example used for planning purposes only and is hypothetical in nature. Actual costs depend on the design on the treatment system.
2. To include drilling and blasting or removal by mechanical means such as a rock saw.
3. Assumes the use of a Gravity Sand Filter
4. Assumes the installation of an UV channel
5. Assumes that the existing influent pumpstation can be modified
6. Assumes that the building will be constructed large enough for one 50,000 gpd packaged treatment plant
5.2.4 Extended Aeration Plant – Marana Package Plant Unit

At the time of this report writing the Marana Wastewater Treatment Facility is in the process of a large treatment expansion. Once the expansion is complete one of three Smith and Loveless 50,000 gpd Factory-Built Addigest Treatment Plants located at the facility will be earmarked for consideration and possible use at the Mount Lemmon WWTF. The Factory-Built Addigest Treatment plant is an aerobic wastewater treatment system designed for municipal and industrial applications. This system offers treatment from basic Biologic Oxygen Demand (BOD) and Total Suspended Solids (TSS) removal to nutrient removal and advanced treatment. The existing Factory-Built Addigest plant located in Marana contains an anoxic tank, a sludge storage tank, an aeration tank, a chlorination tank, and a clarifier. In order for this system to be utilized on Mount Lemmon there needs to be some modifications made to improve the effluent quality. The Addigest Treatment system will need to be retrofitted to incorporate filtration and ultra violet disinfection. A simple process diagram for the retrofitted Addigest Treatment system can be found in Figure 5-8, Addigest Plant Expansion. In addition the cut sheets for the Addigest treatment system installed at Marana can be found in Appendix U.

Range of Flows: It is anticipated that the Addigest Treatment system would be able to handle a wide range of flows because it has an equalization basin built in it. However, during ultra low flow periods it may be difficult keeping the biological process going due to the lack of substrate entering the plant.

Quality of Effluent for Intended Use: It can be expected that the effluent quality of the modified Addigest system in conjunction with UV disinfection can achieve a Class A+ reclaimed water quality or better. Possible options would be to add a Membrane filter such as the Smith and Loveless Titan MBR or the Parkson Corporation Dynalift MBR. The cut sheets for the Titan and Dynalift MBR treatment systems can be found in Appendix V.
Per documentation from Smith and Loveless the Titan MBR addition to the Addigest system can expect the effluent quality to be less than 3 mg/l of BOD and less than 1 mg/l TSS. In addition because the filter pores are less than 0.08 microns in diameter the turbidity is expected to be less than 2 mg/l. However, the cost of retrofiting the Addigest plant with a MBR is approaching the cost of a new MBR system thus placing it in the same category as the MBR section discussed earlier.

Per documentation from the Parkson Corporation the DynaLift MBR features an external membrane system with rugged tubular Ultrafiltration membranes. The membrane pore size of the DynaLift MBR is 0.03 micron thus providing excellent effluent quality. The DynaLift MBR is a standalone system, typically supplied in skids of 10 modules that can typically handle 100,000 gpd of treatment (10,000 gpd per module). The skid would measure approximately 4-feet by 8-feet in size thus is small enough to be placed almost anywhere. The mixed liquor from the aeration tank of the Addigest plant would be pumped through the MBR and the return mixed liquor would return to the anoxic tank. The effluent would then be disinfected by an Ultra Violet system. Finally the capital cost and complexity associated with retrofitting utilizing the DynaLift MBR system is almost half the cost of retrofitting the plant using the Titan system.

**Footprint and Overall Size:** As stated earlier, the lot on which the new treatment process would be located may be one of the most significant limiting factors for the modified Addigest system. This treatment process like all other treatment options would have to fall under BADCT. Under BADCT the set back requirements would be the biggest draw back. Figure 5-9, Addigest Site Plan provides a possible site plan for a modified Addigest plant. Again the biggest lot restrictions would be the 100-yr flood plain to the south of the lot and the set back requirements to the north and west of the lot. In addition because of BADCT the new treatment process would need to be placed inside a building in order to have full noise, odor and aesthetic controls.
**Capital Cost:** The capital cost for adding filtration and UV disinfection Addigest treatment plant would be the most economical of the 50,000 gpd treatment expansions. However, it is still significantly more expensive than only improving the current plant. This is because this option would increase the treatment capacity of the plant significantly and would be placed inside a building in order to have full noise, odor, aesthetic controls. In addition because of the floodplain to the south and potential set back issues to the north additional flood protection may be required. It is estimated that the capital costs for the transfer of the Addigest treatment plant from Marana and the necessary modifications to it would be within the range of **$2.1 million to $4.6 million**. A more detailed breakdown of these costs can be found in Table 5-8.

**Operations and Maintenance Costs:** In relative terms it is anticipated that due to the blowers required for aeration and the fact that chemicals are used to clean the membranes this option should have higher energy consumption and chemical costs than the SBR and the current treatment plant with improvements options. In addition the complexity of this system yields higher replacement costs do to several mechanical control items in the system. This system would have similar operations and maintenance costs to the MBR option mentioned above. See Section 4.5 for additional discussion on operation and maintenance costs.

**Constructability:** Just like the SBR and MBR plant options it is anticipated that the Addigest plant would be constructed above grade thus there would little need for excavation other than foundations. However, due to the floodplain to the south and the set back issue to the north additional flood protection of the plant maybe required.

**Operability / Reliability:** The Addigest plant has been tried and proven to be reliable, and has been in use by Pima County for several years. The system is very familiar to the Pima County staff due to this fact. The normal operations of the plant should be very similar to how it operates in Marana with a few exceptions. The exceptions are as follows:
• The flows on Mount Lemmon will be significantly smaller than when it operated in Marana
• Altitude is significantly higher than in Marana
• Temperature on Mount Lemmon is significantly lower than in Marana by as much as 20 degrees Fahrenheit.
• The plant will be modified to incorporate filtration and disinfection.

Due to these exceptions the biological process may behave differently than in Marana, however the biology should be similar to the current treatment plant currently operating at Mount Lemmon.

**Solids Handling:** Traditionally the sludge production of a properly operated Extended Aeration plant such as the Addigest treatment plant from Marana is higher than an SBR and about 30-40% higher than an MBR. In addition unless there is a grit removal system there would be no inorganic solids removal ahead of the plant. However, by converting the plant to an MBR it is anticipated that the sludge production would be similar to that of the MBR discussed earlier in the report.

**Community Acceptance:** The immediate goal of increasing the treatment capacity would be met by this option. In addition it is not anticipated to have many odor issues because it is an aerated plant. However, the MBR plant would require blowers which create some potential noise issues. Sound dampeners would need to be added to the blower system which would add some additional capital cost.
### TABLE 5-8 TRANSFER EXISTING MARANA TREATMENT PLANT\(^1\).

**PROBABLE CONSTRUCTION COST RANGE**

<table>
<thead>
<tr>
<th>Item #</th>
<th>Installed in Place</th>
<th>Unit</th>
<th>Quantity</th>
<th>Unit Price</th>
<th>Total</th>
</tr>
</thead>
<tbody>
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<td>1</td>
<td>Mobilization and Demobilization</td>
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<td>1</td>
<td>$150,000</td>
<td>$150,000</td>
</tr>
<tr>
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<td>Site Earthwork(^2)</td>
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<td>$247,500</td>
<td>$247,500</td>
</tr>
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<td>MBR Filtration System(^3)</td>
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<td>$525,000</td>
<td>$525,000</td>
</tr>
<tr>
<td>4</td>
<td>Ultra Violet Disinfection(^4)</td>
<td>LS</td>
<td>1</td>
<td>$70,000</td>
<td>$70,000</td>
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<tr>
<td>5</td>
<td>Yard Piping</td>
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<td>1</td>
<td>$90,000</td>
<td>$90,000</td>
</tr>
<tr>
<td>6</td>
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<tr>
<td>7</td>
<td>Effluent Pump Station</td>
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<td>$250,000</td>
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<td>$40,000</td>
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</tr>
</tbody>
</table>

**SUBTOTAL**

30% Contingency

**TOTAL**

$3,042,975

**PROBABLE COST RANGE**

- 30% TO +50% $2,130,083 TO $4,564,463

---

\(^1\) This is an example used for planning purposes only and is hypothetical in nature. Actual costs depend on the design of the treatment system.

\(^2\) To include drilling and blasting or removal by mechanical means such as a rock saw.

\(^3\) Assumes the use of MBR Filtration

\(^4\) Assumes the installation of an UV channel

\(^5\) Assumes that the existing influent pumpstation can be modified

\(^6\) Assumes that the building will be constructed large enough for one 50,000 gpd packaged treatment plant
5.2.5 Treatment System Conclusion & Recommendations

There are many challenges that must be overcome before any treatment expansion on Mount Lemmon. Some of these obstacles include, but are not limited to:

- Various effluent disposal restrictions; this includes legal, environmental, and/or permit restrictions as discussed in Section 3.0 and called out in this section must be considered in the implementation of this plan.
- The existing lot is small and careful planning is needed to make sure that components will fit on the lot and that future expansion units can be placed along side later.
- The new treatment option needs to meet new facility BADCT treatment performance standard discharge quality and also meet future treatment regulations.
- Noise, odor, and aesthetic control setback issues need to be carefully considered in implementation of this plan.
- Many physical restrictions such as the floodplain to the south of the lot and the set back requirements to the north must be considered in design of the upgrade and expansion to ensure compliance with Aquifer Protection Permit requirements.

Given all of these obstacles, selecting the one treatment system that can accommodate them had been the focus of this section of the report.

Adding improvements to the current plant in order to improve the effluent quality may be the most economical solution but it has many drawbacks which must be considered in the planning process. One of the drawbacks would be that it does not increase the capacity of the treatment facility to provide a buffer to PCWMD in case actual flows associated with re-development are greater than projected flows. Given that redevelopment trends are towards larger homes with greater flows, this may not provide a margin of safety factor to PCWMD to ensure compliance with regulatory limits in permits. In fact upgrade may actually de-rate the plant do to the backwash required for a sand filter with de-nitrification capabilities and issues associated with addressing high influent nitrogen concentrations may greatly impact the function of upgraded units. In addition any modifications performed to the plant must result in effluent quality that meets new
facility BADCT treatment performance standards pursuant to A.A.C. R18-9-B204, and if discharged to Sabino Creek, must also Arizona Surface Water Quality Standards (See Section 3.0). If this option is selected, Pima County should carefully look at how these improvements will change current USFS SUP and AZPDES permits. Further an individual APP will be required for this upgrade.

The SBR option is a viable option for a treatment plant expansion. It can produce high quality effluent. It can handle a wide range of flows and should have lower operations and maintenance costs than the MBR system. When comparing head to head with an MBR the SBR is very comparable with all of the criteria assessed in this report. It will also result in reduced biosolids by a factor of 75% and this may help alleviate stakeholder concerns regarding trucking of sludge down Catalina Highway and associated risks.

The final two options assessed in this report are essentially both membrane bioreactors. The only difference between them is the initial capital cost. The greatest benefit of an MBR is the effluent quality. This is because the membranes have porosities ranging from 0.1 to 0.4 microns (depending on the manufacturer), which is considered between micro and ultra filtration.

Assuming that a new treatment plant is selected to replace the current plant there are some possibilities of reusing the old plant to perform new functions. Some of these functions could include reusing the existing tank for equalization and grit removal, or reclaiming the building for additional expansions. All of these possibilities should be assessed during the design of the new plant expansion to see if these units can be incorporated into the new WWTF.

Based on a full analysis of all factors including stakeholder input and cost, use of a SBR to replace the current WWTF is recommended for the Mount Lemmon WWTF. Further rather than upgrade, full replacement of the current plant by 2012 is recommended to ensure that there is an adequate margin for addressing peak flows with treatment. This must be coupled with off-site methods for
addressing peak flows to maintain compliance with permit discharge limits such as storage tanks and flow equalization. Construction of a 50,000 gpd plant will allow PCWMD to accommodate changes in flow, still treat effectively at low flows, and address peak flows. This replacement of the current plant with a new SBR will require amendment of the USFS SUP and AZPDES permit for a higher treatment capacity plant with discharge limits consistent with current permits, and also will require obtaining an individual Aquifer Protection Permit.

5.2.6 Copper and Zinc Removal:- Advanced Treatment
Assuming that zinc and copper can not be handled at the source a treatment process such as an ion exchange technology could be used to reduce the copper and zinc levels to the discharge limits. This can be accomplished by utilizing chelated resins that have been tailored to remove copper and zinc ions from the effluent.

The ion exchange process works as solutions of copper or zinc pass through the chelating resin, they are exchanged for the sodium at that site. Two possible chelating resins that could be used for copper and zinc removal are the Lewatit TP 207 resin and the Amberlite IRC-718 resin. The cut sheets for the chelating resins can be found in Appendix Z.

Most ion exchange process applications use a fixed-bed column system. The fixed-bed column system that could be used for the Mount Lemmon treatment facility could be a skid mounted column approximately 14-inches in diameter and 4-feet tall. Once the resin media is spent it can then be regenerated onsite. However, regeneration of the media onsite would require an extensive acid backwash, and caustic soda backwash, and therefore is not recommended to have onsite regeneration for such a small plant. However, it is anticipated that the media would last up to 6 months to a year and would have a replacement cost from $2,500 to $5,000 per year.
The capital cost for a fixed-bed column ion exchange treatment system to remove copper and zinc can range from $10,000 to $20,000.

5.3 Disposal Technologies

Disposal of Treated Effluent
Section 3.0 developed a parallel pathway approach to address objectives for this project. Various disposal options were identified as feasible in the regulatory evaluation performed using the decision matrix. Detailed discussion regarding options can be found in Section 3.0. Based on the regulatory environment and geologic environment, only a limited number of disposal or use options were carried forward for engineering and cost evaluation to this portion of the study. The options assume that the treatment plant is upgraded or replaced in 2012 to include dechlorination, denitrification, filtration, and possibly advanced treatment to decrease copper and zinc concentrations. The options identified as feasible are:

- Installation of an off-site storage tank to use as firefighting water supply and reclaimed holding capacity and use of reclaimed water for firefighting;

- Development of reclaimed areas to grow trees in either the Sabino Creek Watershed or San Pedro Watershed. EEC identified several preliminary areas one located north of Marshall Gulch and one located adjacent to the Old Sawmill site. Private land options will take additional assessment and followup with residents and land owners in the Community which are beyond the scope of this planning document;

- Development of an outfall to Sabino Creek;

- And continued use of the current sprayfield in conjunction with options identified above.
Conceptual costs for planning and assumptions used to develop the costs are provided in this section and include preliminary estimates of not only engineering design and construction, but also permitting.

This study recommends that PCWMD develop 4 disposal methods for treated effluent from the expanded plant so that options are maximized for beneficial use, and enhancing base flow in Sabino Creek to support T&E species in the Creek.

**Off-site Storage Tank**

EEC has provided costs for development of a 100,000 gallon storage tank site, potentially on USFS land near the current fire station for access for water supply during fire fighting (Figure 5-10). Costs assume that a 3000 gallon dip tank is installed above the tank to allow helicopters to fill buckets from above the storage tank without landing. The location of the tank is best selected to be at or near the ridgeline to allow development of other beneficial uses such as irrigation of forest land. Costs assume that piping to the tank can branch off from the existing pipeline to the spray field – from above the pump station.
## TABLE 5-9 WEST SAWMILL

### 100,000 GALLON EFFLUENT HOLDING TANK 

**PROBABLE CONSTRUCTION COST RANGE**

<table>
<thead>
<tr>
<th>Item #</th>
<th>Installed in Place</th>
<th>Unit</th>
<th>Qty</th>
<th>Unit Price</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mobilization and Demobilization</td>
<td>LS</td>
<td>1</td>
<td>$30,000</td>
<td>$30,000</td>
</tr>
<tr>
<td>2</td>
<td>Site Earthwork</td>
<td>LS</td>
<td>1</td>
<td>$10,000</td>
<td>$10,000</td>
</tr>
<tr>
<td>3</td>
<td>100,000 gallon Storage Tank</td>
<td>LS</td>
<td>1</td>
<td>$100,000</td>
<td>$100,000</td>
</tr>
<tr>
<td>5</td>
<td>3,000 gallon Dip Tank</td>
<td>LS</td>
<td>1</td>
<td>$4,000</td>
<td>$4,000</td>
</tr>
<tr>
<td>6</td>
<td>Yard Piping</td>
<td>LS</td>
<td>1</td>
<td>$25,000</td>
<td>$25,000</td>
</tr>
<tr>
<td>7</td>
<td>Miscellaneous Appurtenances</td>
<td>LS</td>
<td>1</td>
<td>$40,000</td>
<td>$40,000</td>
</tr>
</tbody>
</table>

**TOTAL**

$209,000

**PROBABLE COST RANGE - 30% TO +50%**

$146,300 TO $313,500

---

1. This is an example used for planning purposes only and is hypothetical in nature. Actual costs depend on the design.
2. Requires minor site work assumeing that it be located near the current helicopter landing pad.
3. Estimate does not include the cost of property or easement acquisition.
4. Option assumes the use of the current effluent disposal piping.
Reclaimed Irrigation Areas

EEC has developed costs associated with irrigation of two preliminary irrigated areas for reforestation with native trees that can uptake water during winter months. Costs assume a phased on growth plan. This system is designed with a subsurface drip irrigation system placed below the frost zone and at the root zone of saplings. Two potential locations were identified for the purpose of capital cost planning – an area north of Marshall Gulch and an area west and south of the Old Sawmill site (north of Summerhaven). Both of these areas are on USFS. Studies for implementing this plan must include development of site selection criteria, scoping, site selection, demonstration that private land is not available, and NEPA processes for use of USFS land through special use permits.

Reclaimed wastewater could potentially be used to irrigate native tree seedlings at consumptive use application rates for beneficial use to enhance the visual resources in and around Summerhaven. Suitable sites could be on either private or USFS land. For the purposes of cost estimation and conceptual development, this study has identified two potential areas of USFS land: one west of the old sawmill site north of Summerhaven and one at Carter Canyon and within 2000 feet south of the current WWTF. Both would be visible upon driving into Summerhaven from Catalina Highway (Figure 5-10, Conceptual Location of Irrigated Fields and Tanks).

Use of USFS land would require approval by the Forest Manager for consistency with the Forest Plan, and would also have to meet NEPA requirements. It would also require that all options for use of private land were infeasible.
Figure 5-10

Legend

- Conceptual Storage Tank Locations
- Conceptual Irrigation Fields (approx. 70 acres each)
- 2000 ft. Pipe Section

Mount Lemmon Study
The strategy of development starts with planting seedlings mid-2011 or early 2012 after an upgraded WWTP has been constructed and permitted and treated effluent is meeting new facility BADCT treatment performance standards and achieves A+ or A reclaimed quality. Development of a sufficient acreage of seedlings will ensure that as the trees mature water use will increase and parallel the increase in flows projected for the WWTF so that the majority of the reclaimed water, even in winter months, will be taken up through consumptive use by the trees. This option is consistent with stakeholder feedback during public meetings conducted as part of this study and is a feasible method of wastewater management that will reforest highly scared areas that were formerly covered in conifer forest.

Data Gaps – success of this reclaimed use will depend on research, soil testing, and monitoring of evapo-transpiration rates (ET) to ensure that long term goals will be achieved for growing mature trees and applying water at proper rates for consumption.

If USFS land is used, PCWMD will need to enter into consultation with the USFS to determine the extent and range of opportunity for this option. The option is conceptually presented here for decision making.

The concept of this option assumes that the rates of application within targeted reforestation areas equals that of the effluent discharged daily and that future increases in flow with community redevelopment will be paralleled by increased uptake, if acreage and numbers of trees are adequately planned and developed.

In cases where supplemental water has been used for reforestation, systems have tended to be temporarily maintained during a minimal establishment period. With reclaimed water discharge flow rates increasing yearly, and with the goal of using reclaimed water for the benefit of the community, the concept proposed here is envisioned to continue on indefinitely or until another area is phased in.
The WWTF currently disposes of treated effluent. Rather than disposal, this option consists of beneficial use of reclamation of water to grow trees at a rate that is equal to the discharge rate of the plant. This option can be used alone or combined with other disposal or reuse options.

The project implementation schedule for upgrade of the WWTF consists of construction of a new WWTF and start up in 2011. The schedule associated with this option assumes that it will not be implemented prior to plant startup – because B quality reclaimed use permitting would require control of access to the area. This would mean fencing off a 70 acre area which would not only be expensive, would also present logistical and NEPA issues if the project is located on USFS land.

After start up of the replacement WWTF, reclaimed effluent of A to A+ quality would be available for irrigating the seedlings. Indigenous forest tree species will be established from seedling stock (possibly in cooperation with Trees for Mount Lemmon) which will extract minimal amounts of moisture in the early years of development. The major component of ET during this phase will be evaporation with some root uptake. With application of water at consumptive use and evaporation rates in 2011-2012, the growth of these seedlings will eclipse those of non-irrigated plants. The reforested areas should produce a living system that can begin to accept the volume of reclaimed water produced by the WWTF (around 8000 gpd in 2011-2012) and keep pace with increasing flow rates. Strategic planning for this option will need to include balancing plant uptake during winter months with use of the spray field to ensure that reclaimed water is only applied at consumptive use rates. Studies performed will include site specific data collection for a one year period of time and consumptive use modeling.
Spatial Needs

The sizing of the area to support this concept is based on the evapo-transpiration potential of the reforested plant community or system at various stages of its evolution. The process used to determine the approximately area necessary to accept the project flows at consumptive use rates follows this path:

1) The ET, for the plants with known ET rates adjusted for Mount Lemmon

2) The evaporation from the soil surface will be increased to reflect the low surface coverage effect of the first succession plant communities within the early years (2013-2017) and was then factored into ETo

3) The monthly use was established based on canopy size and height

4) The spacing was determined using 70% an assumed canopy width for a mature tree. Based on a mature canopy width of 20 feet, the average spacing will be approximately 18 feet on center. At this spacing each acre will receive 156 trees. The initial planting of seedlines will be at a much greater density and during the 20 year period of development there will be a natural reduction in density as well as through physical thinning operations.
### TABLE 5-10 Approximate $E_{To}$

<table>
<thead>
<tr>
<th>Month</th>
<th>Flagstaff</th>
<th>Payson</th>
<th>Mt. Lemmon (extrapolated)</th>
<th>Tucson</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>0.041</td>
<td>0.046</td>
<td>0.048</td>
<td>0.072</td>
</tr>
<tr>
<td>Feb</td>
<td>0.054</td>
<td>0.059</td>
<td>0.063</td>
<td>0.097</td>
</tr>
<tr>
<td>Mar</td>
<td>0.116</td>
<td>0.132</td>
<td>0.135</td>
<td>0.178</td>
</tr>
<tr>
<td>Apr</td>
<td>0.184</td>
<td>0.207</td>
<td>0.213</td>
<td>0.268</td>
</tr>
<tr>
<td>May</td>
<td>0.221</td>
<td>0.259</td>
<td>0.256</td>
<td>0.301</td>
</tr>
<tr>
<td>Jun</td>
<td>0.253</td>
<td>0.295</td>
<td>0.293</td>
<td>0.339</td>
</tr>
<tr>
<td>Jul</td>
<td>0.252</td>
<td>0.198</td>
<td>0.292</td>
<td>0.307</td>
</tr>
<tr>
<td>Aug</td>
<td>0.166</td>
<td>0.201</td>
<td>0.193</td>
<td>0.229</td>
</tr>
<tr>
<td>Sep</td>
<td>0.187</td>
<td>0.141</td>
<td>0.217</td>
<td>0.233</td>
</tr>
<tr>
<td>Oct</td>
<td>0.129</td>
<td>0.134</td>
<td>0.150</td>
<td>0.184</td>
</tr>
<tr>
<td>Nov</td>
<td>0.101</td>
<td>0.104</td>
<td>0.117</td>
<td>0.136</td>
</tr>
<tr>
<td>Dec</td>
<td>0.07</td>
<td>0.073</td>
<td>0.081</td>
<td>0.098</td>
</tr>
<tr>
<td>Average (daily) $E_{To}$</td>
<td>0.148</td>
<td>0.154</td>
<td>0.171</td>
<td>0.204</td>
</tr>
<tr>
<td>Cumulative (annual) $E_{To}$</td>
<td>54.09</td>
<td>60.85</td>
<td>74.91</td>
<td></td>
</tr>
</tbody>
</table>

Table 5-10- Evapo-transpiration Data
Assumptions used to develop this concept are presented in this section and include two tables: Approximate ETo Table 5-11 Water Consumption Table. Using the Water Consumption Table the lowest demand will occur in January with a low of 23 gallons per month or 0.74 gallons per irrigated plant per day. The effluent received is projected to be approximately 8,000 gallons per day in 2011-2012 based on flow projections.

- No. of trees required = effluent applied/plant demand (ETo)
- No. of trees required = 8,000 pgd/0.74 gpd
- No of trees required = 10,796 trees

At 156 trees per acre, the area required to accommodate the expected flows during the first year will be 69.2 acres or roughly a 70-acre tract. Two potential
conceptual tracks have been identified on USFS land, for discussion and illustration purposes (Figure 5-10). The actual sites will depend on site selection, scoping and regulatory negotiation.

The system will be designed for the water quality of the reclaimed water from the upgraded Mount Lemmon WWTF which is located at the southern end of Summerhaven. A main will be constructed from the existing pipeline to the spray field to a storage tank located either near the current fire station for the West Sawmill Conceptual Site or the Carter Canyon Site. The distribution will be composed of:

1) Control System to monitor the system and the environmental conditions at the site
2) Distribution System to be installed below the frost line and winterized as necessary (including warm water circulation to prevent freezing of lines)
3) Application components incorporating pressure compensating emitters, distribution riders, all with drain down capacity, and
4) Tailing water drain down below grade (if needed) designed to be exempt from APP permitting and for ease of construction.

The entire system will be designed for operation at 20 psi with an assumed system pressure loss of 4 psi. The total head will be approximately 55.4 feet. The treated effluent is classified as non-potable and as such no backflow prevention device is proposed and the areas will be selected to be separated from possible potable water sources. If it becomes necessary, an additional 4 to 5 psi would be required for system design. All distribution pipe and laterals will be PVC class 315 installed with a minimum slope of 3% to allow for complete drain down after application system and topographic contours will be followed as needed to maximize distribution. The depth of setting will be below the frost line in the selected areas. The system will be designed to reduce or eliminate the need for tail down field.
Site specific studies would be needed for landscape irrigation design. In developing these costs, the following were used for site suitability environmental requirements or baseline assumptions:

1) Soil moisture is adequate and below field capacity;
2) Rainfall during the summer averages 62” and winter 47.5”;
3) The daily wind speed is an average 5.2 mph during the summer and the winter is 3.8 mph;
4) The solar radiation is 692 langleys / day at the summer peak (June) and 293 langleys at January winter low;
5) The plant species is to be Ponderosa Pine (Pinus ponderosa var. arizonica) or other suitable native species (aspen or white fir) selected for maximum winter uptake and suitability for project

Actual data will need to be used in developing designs for the irrigation project.

The following growth and management factors were used in developing conceptual strategy and costs:

1) Plant development is assumed to be 4’ tall in 2011/2012 with a canopy of 1.67’. This assumes areas that are reforested by spring of 2008 and develop normally.
2) Plant size will be 40’ tall in 2022 with a canopy of 15’ if started no later than in 2012.
3) Selective thinning will be performed in 2018.
4) Monitoring of the irrigated reforestation area will occur on a periodic basis and where growth projections either for the urban development or the plantings adversely affect the performance, additional areas adjacent to the initial plantings may be developed in phases.

The following evapo-transpiration (ET) information was used in developing conceptual strategy and costs:

1) The reference $ET_0$ assumed to be based on the AZMET data.
2) The reference ET₀ for Mt. Lemmon has been adjusted using data obtained from stations at Flagstaff and Payson, Arizona. Actual site specific data should be collected for use in landscape design.

3) The crop factors have been adjusted using the reference ET₀ adjustment factor.

4) The average reference evapo-transpiration per month is based on data from 1987 to 2002 (15 years).

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
<th>Total Capital Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seedling Cost (per USFS stds)</td>
<td>$92,750.00</td>
<td></td>
</tr>
<tr>
<td>Monitor and system control</td>
<td>$20,000.00</td>
<td></td>
</tr>
<tr>
<td>Distribution System (POC to plants)</td>
<td>$185,000.00</td>
<td></td>
</tr>
<tr>
<td>Emitters, risers and feeder tubing</td>
<td>$30,000.00</td>
<td></td>
</tr>
<tr>
<td>Drain components</td>
<td>$5,000.00</td>
<td></td>
</tr>
<tr>
<td>Site development and finish grading</td>
<td>$20,000.00</td>
<td>$352,750.00</td>
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<tr>
<td>Conceptual Cost Range (-35% Plus 50%)</td>
<td>$246,925.00</td>
<td>to $529,125.00</td>
</tr>
</tbody>
</table>

This is an example used for planning purposes only and is hypothetical in nature. Actual costs depend on the design. This cost does not include regulatory costs.
<table>
<thead>
<tr>
<th>Item #</th>
<th>Description</th>
<th>Unit</th>
<th>Qty</th>
<th>Unit Price</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mobilization and Demobilization</td>
<td>LS</td>
<td>1</td>
<td>$30,000</td>
<td>$30,000</td>
</tr>
<tr>
<td>2</td>
<td>4-inch HPDE Effluent Disposal Piping &amp; Excavation², ⁴</td>
<td>LF</td>
<td>2000</td>
<td>$150</td>
<td>$300,000</td>
</tr>
<tr>
<td>3</td>
<td>Site Earthwork²</td>
<td>LS</td>
<td>1</td>
<td>$90,000</td>
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<td>5</td>
<td>100,000 gallon Storage Tank</td>
<td>LS</td>
<td>1</td>
<td>$100,000</td>
<td>$100,000</td>
</tr>
<tr>
<td>6</td>
<td>3,000 gallon Dip Tank</td>
<td>LS</td>
<td>1</td>
<td>$4,000</td>
<td>$4,000</td>
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<td>7</td>
<td>Yard Piping</td>
<td>LS</td>
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<td></td>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>$589,000</strong></td>
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</table>

**PROBABLE COST RANGE - 30% TO +50%** $412,300 TO $883,500

1. This is an example used for planning purposes only and is hypothetical in nature. Actual costs depend on the design.
2. To include drilling and blasting or removal by mechanical means such as a rock saw.
3. Estimate does not include the cost of property or easement acquisition.
4. Quantity of pipeline is an assumption and may be more or less depending on the final alignment.
Outfall to Sabino Creek

There are two possible options for the discharge into Sabino Creek. The first option would be to discharge just south of the plant within the Carter Canyon drainage that bisects the Pima County lot located south of the WWTF lot. The second option consists of pumping the effluent up Sabino Creek using the current effluent force main and discharge upstream that leads from the current plant up to the Spray Field, and connecting a pipe that discharges to Sabino Creek from this pipeline. For the second option to be viable, the location will need to be carefully selected to ensure that it is downstream of domestic water supply sources (Figure below, Project Watershed Hydrology).

The capital costs for both options are estimated to be approximate $20,000 dollars however there are associated extra permitting costs and possible rights-of-way acquisition associated with pumping and discharging upstream of the plant. The regulatory costs associated with this option are estimated to be up to and possibly more than $1,000,000.00, based on USFS indication that a full EIS is likely to be required since that Sabino Creek flows through the Pusch Ridge Wilderness Area. The USFS out-source cost of this may in itself be a stand alone cost of $0.5 M. This is a sizable investment for a single option. If the rule prohibiting discharge to Sabino Creek is revised to allow this discharge, this study recommends that this option be combined with other options that develop beneficial use in the watershed such as firefighting and reforestation irrigation.

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
<th>Capital Cost (total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct Outfall</td>
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<td></td>
</tr>
<tr>
<td>Permitting</td>
<td>$1,100,100.00</td>
<td>$1,120,000.00</td>
</tr>
<tr>
<td>-30% plus %50 range</td>
<td>$784,000.00</td>
<td>$1,680,000.00</td>
</tr>
</tbody>
</table>
Figure 5-11

Mt. Lemmon Service Area Watershed Study & Wastewater Management Plan (Project No. 206145)

Legend
- Springs
- A/IFT Shuttered Wells
Watershed Boundaries
- Spray Field
- Sabino Creek
- Roadways
- Watersheds

Aerial Image from October 2002

Miles
0 0.125 0.25 0.5

JOB NO.: 6-115-005017
DESIGN: EG
DRAWN: EMP
DATE: 06/19/2007
SCALE: 1" = 0.25mi

Mt. Lemmon Service Area Watershed Study and Wastewater Management Plan
Project Watershed - Hydrology

Figure 5-11
**Continued Use of the Spray Field**
Costs assume that the spray field can continue to be used even after other disposal options are developed – as a contingency. No capital costs are associated with this, since this field has already been developed.

**Disposal Options for Biosolids**
As part of this study, the team assessed available methods for disposing of biosolids. These included:

- Continue trucking of un-thickened waste to discharge manhole.
- Allow gravity thickening in the sludge handling tank for any process.
- Convert treatment process to SBR or MBR and reduce sludge quantity by 30% to 75%.
- Install an anaerobic or aerobic digester on site to produce either Class-B or Class-A biosolids.
- Add a belt filter press to increase percent solids from any treatment process.
- Final disposal in a landfill
- Final disposal by land application

Of these options the two that are most cost effective are: continued trucking of biosolids and disposal at manholes or processing for disposal at a landfill.
6.0 Ecological Issues

6.1 “Sky Island” Factors

The Santa Catalina Mountains are biogeographically considered a “sky island.” They rise from a base of 3,000 feet to over 9,000 feet and include montane vegetation and wildlife species whose available habitat is limited as compared to the “sea” of desert below. Several mountain ranges in southeastern Arizona are part of the “sky island” region of southeastern Arizona, southwestern New Mexico, and northern Sonora and Chihuahua. These include the Santa Catalina, Rincon, Santa Rita, Pinaleno, Huachuca, and Chiricahua Mountains among others. Most rise above 8,000 feet; the crest of the Pinalenos, Mt. Graham, rises to nearly 11,000 feet. The montane habitat on these sky islands is not only uncommon in the Sonoran Desert and Chihuahuan Desert but also in the continental United States. The strong Madrean influence from Mexico adds diversity and a host of new species to these forests that are not seen north of the region. Several species from further south reach their northern extent in these mountains (e.g., silverleaf oak [Quercus hypoleucoides], Chihuahua pine) and many species from further north reach their southern extent (e.g., Englemann spruce [Picea englemannii]). The sky island region is significant due to its rich diversity of species and habitats and as some of the last North American strongholds for such predators as the Mexican gray wolf (*Canis lupus baileyi*), black bear, mountain lion, and jaguar (*Panthera onca*) (Sky Island Alliance 2006). The ecosystems of each sky island mountain range are of major interest to resource managers concerned with preserving each sky island’s unique biogeography and biological diversity.

The elevation change in and diversity of vegetation in the sky island ranges is remarkable and unparalleled in the conterminous United States. The foothills of the Santa Catalina Mountains are characterized by Sonoran Desert scrub while less than an hour’s drive away one finds forests of subalpine fir and aspen, plants typically found in a boreal environment on high mountains and well into Canada. Adding to the unique character of the Santa Catalina Mountains is Mt. Lemmon Ski Valley, the southernmost ski area in the United States. The ski area lies on cool northeast-facing slopes just below the summit of Mt. Lemmon and is only about 80 miles from the Mexican border.
Also of note is the preponderance of surface water in the range, a rarity in a largely arid region, that includes several streams and numerous springs. Sabino Creek is one of a handful of perennial or near-perennial creeks that flow in the Sonoran Desert, though historically rivers such as the Santa Cruz, Gila, and Salt flowed through large expanses of the desert. Sabino Creek is designated an Important Riparian Area and a Perennial Stream Special Element by Pima County’s Planning Division. The Tucson Audobon Society has deemed it eligible for classification as an Important Bird Area, and the Federal Government has deemed it eligible for Wild and Scenic River status.

6.2 Water Needs
The Summerhaven area is a mountainous region dense in riparian habitat and is continually sensitive to the potential damage of wildfires, as it has been in the past (i.e. Bullock and Aspen Fires). As land development progresses, consideration must be made with regard to maintaining stable environmental conditions. As part of that consideration, water needs of the watershed must be balanced and sustained with development. Several possibilities exist for the use of appropriately treated reclaimed water, including fire suppression, residential reuse, and snowmaking. The following sections address the main water needs of the habitat of Sabino Creek Watershed.

6.2.1 Fire Protection
As discussed previously, the Mt. Lemmon area is part of the Coronado National Forest, and susceptible to fire damage. The upper portion of the Sabino Creek Watershed is the one part of the region that was not affected by the Aspen Fire. As Boyle (2007) indicates, the majority of the region’s water sources and storage tanks are located in this portion of the watershed and the potential for this area to burn persists, which could cause significant damage to the watershed and the community infrastructure.

Managing the fire protection water needs in the long-term could be done by using the WWTF effluent. Repurposing the WWTF effluent for fire suppression within the watershed would reduce the volume of potable water needed to be withdrawn from storage tanks. Eliminating fire protection water needs from the potable
water supply could mitigate the potential for impacts to occur in the watershed from groundwater pumping that would be used for replenishing potable water storage.

### 6.2.2 Snowmaking

The possibility of using treated effluent for snowmaking at Mt. Lemmon Ski Valley would be a significant environmental issue. This option was previously considered in the initial EIS study (1975) for the current system but was dropped, largely because a storage tank with a large enough capacity was not available (Finical and Dobrowski 1977). There are currently two 500,000-gallon storage tanks atop the mountain that could be used to hold water for this purpose.

There would be immediate socioeconomic and recreational benefits to utilizing reclaimed effluent for snow making in the community; Ski Valley would have a more consistent snow season and higher-quality ski conditions. Having more water stored in the snowpack for a later and slower release would delay some runoff into late spring, contributing water to the watershed in a typically dry time of the year.

However, other issues may off-set the benefit of using reclaimed water for snowmaking, such as the cost of installing a conveyance system and NEPA related requirements. A detailed discussion related to this topic was provided in Section 3.0 of this report.

### 6.3 Watershed Balance

Performing a true watershed balance for this area cannot be done without a full hydrologic study including data collection, fracture assessment, geophysical surveys, testing to determine aquifer properties, and subsurface exploratory borings would be needed to perform an accurate water balance for the watershed. Previous attempts to perform a resource assessment have indicated that collection of hydrologic data is required. In the January 2001 report entitled *Hydrologic Resource Assessment of Upper Sabino Creek Basin, Pima County,*
Arizona prepared by Christopher J. Peters and Roger C. Bales of the University of Arizona Department of Hydrology and Water Resources, the authors identified data needs and provided recommendations (Appendix W). At this time the absence of comprehensive hydrologic data and geologic data limits conclusions that can be made (2001) and future planning.

In the context of this report, watershed balance refers to the need or desire to maintain a sustainable water balance among the watersheds affected by ground water and surface water withdrawal, and wastewater disposal, in the Mt. Lemmon area. Only two watersheds were considered in this assessment: the Sabino Creek watershed in which the WWTF service area is located and the Alder Creek watershed (part of the San Pedro River Watershed) which contains the effluent spray fields. Water transfers are strictly one way, with the Sabino Creek watershed experiencing a net loss of water and the Alder Creek watershed experiencing a net gain based on current disposal practices. The effect of the water transfer is not equivalent. Treated effluent transferred from the Upper Sabino Creek watershed could have contributed to stream flow to maintains high-value aquatic and riparian habitats below Summerhaven. The effluent water quality produced by the plant at this time, would not however meet standards designated for Sabino Creek. Therefore returning the water to the Creek is not possible at this time without upgrading the WWTF in addition to revising rules which prohibit discharge to Sabino Creek.

Treated effluent transferred into the Alder Creek watershed does not contribute to streamflow but either evaporates directly into the atmosphere or soaks into the forest floor where it is transpired by vegetation.

In her master’s thesis, Boyle (2007) discusses the key issues and concerns related to watershed balance in terms of water rights, use permits, regulatory restrictions, and habitat protection. Concerns about water quality in both the upper and lower reaches of Sabino Creek brought on the regulatory requirement for the WWTF to dispose of treated effluent outside the source watershed. This
led to the Forest Service permit that controls the amount of effluent that can be transferred to the Alder Creek spray fields. Disposing of the effluent versus beneficial use for various purposes, regardless of the watershed, are also of concern to the USFS.

Subsequent concerns about the potential negative impact of water transfers on important wildlife habitat within Sabino Creek, and the prospect that new claims on remaining water rights could reduce stream flow even further, led to the Sierra Club and then the Forest Service to apply for instream flow rights in 1987. The conflict over water rights and the desire to preserve instream flow to sustain downstream habitat has been a significant consideration in the planning and design of a new WWTF.

Following the Aspen Fire, Summerhaven residents and stakeholder groups organized public meetings to discuss issues of concern and potential solutions for post-fire recovery (Boyle, 2007). A stakeholder meeting held on 4/2/2005 emphasized the desire for a “balanced” approach both in ecological and economic terms, and led to these themes (among the four):

- Healthy forests and watersheds through sustainable and balanced forest management, planning and collaboration.
- A balance between natural systems and community needs through a process of

Among the many actions proposed at this stakeholder meeting, several related to watershed balance, including:

- Keep water in Sabino Watershed, including returning treated wastewater that is currently discharged into the San Pedro watershed.
- Re-evaluate treated wastewater policy.
- Evaluate the sources of conflict related to water rights and instream flow.
Similar sentiments were expressed at the public workshop held on February 12, 2007 as part of this study. Key issues related to watershed balance, extracted from Section 2.5.5, above, are as follows:

- Return treated effluent back in Sabino Creek to increase stream flow (opportunity).
- Retain water taken from Sabino Creek back to the creek to maintain natural flow regime (opportunity).
- Remove legal restraints to discharge treated effluent into Sabino Creek (goal and opportunity).
- Manage vegetation to enhance in-stream flow (opportunity).
- Keep water taken from the Sabino Creek watershed in the watershed (goal and opportunity).
- Input treated effluent at upper end of Sabino Creek watershed (goal).

Although the Forest Service, MLWID, and other stakeholders have voiced a desire to reuse treated effluent within the Sabino Creek watershed to improve streamflow conditions, they have also expressed a number of other possible uses, including landscape irrigation, that would lose water from the system through evapotranspiration. The potential effect of various management and design options for the WWTF on watershed balance are explored in detail in Section 8.0 Management Issues.

In order to perform a watershed balance and assess impact of current and future practice and policy, data collection is needed. This study recommends that Pima County work in partnership with the USFS, the University of Arizona and the Water Research Institute, and possibly the USGS to perform a comprehensive water resource investigation for the Summerhaven area. History has already shown the water resources on the mountain are limited by the geologic environment and drought, as part of plans to redevelop, a thorough hydrologic assessment is recommended, including assessment of fractures and fracture flow.
6.4 **Recreational Use**
The Santa Catalina Mountains are an important retreat for residents of the city of Tucson. In particular, during the summer months the forested higher elevations in and around Summerhaven serve as a refuge for residents of Tucson to escape the hot temperatures in the surrounding desert. There are well-developed recreational facilities in the upper basin including trails, picnic grounds, campgrounds, and a ski area. The lower basin also has well-developed facilities including the shuttle up Sabino Canyon Road. Recreational uses in the area include hiking, rock climbing, fishing, skiing, camping, mountain biking, hunting, picnicking, bird watching, sightseeing and car-based tourism, dining, and sky rides. The Sabino Creek watershed sees moderate to heavy visitor use in its upper and lower reaches. Sabino Creek is the only perennial stream accessible by automobile within 50 miles of Tucson (Finical and Dobrowski 1977) and thus is a rare and valuable recreational resource to local residents.
7.0 Emerging Conditions

7.1 Growth

Sewer Basin Planning Area Defined

The existing sewer basin for the Summerhaven service area is composed of approximately 47 original sewer service lots identified and included in the USFS SUP. PCWMD has also identified an additional 30 lots that front the collection mains and sewer service that could be easily connected to the sewer system, if capacity at the wastewater treatment facility allows. The USFS SUP was amended to include an additional 30 first come first served connections. Sewer Basin Exhibit 3 identifies the original 47 sewer service permits and an additional 30 lots that front sewer service. Lots that currently have septic systems are also identified on this exhibit. The thick line on the exhibit identifies the existing sewer basin area.

If expansion of the wastewater treatment system is not the limiting factor, then expansion of the sewer basin is possible. However, construction costs of gravity sewer mains, forcemains, manholes and the number of feasibly buildable lots will determine the actual expansion of the sewer basin. Exhibits 1 and 3 illustrate the entire Mt. Lemmon community. To determine how much the sewer basin can actually expand, several items were evaluated such as; construction costs, feasibly of home building, and distance from current sewer basin.

It should be noted that within the primary sewer basin planning areas as defined by EEC and PCWMD, there are a total of 679 lots, of which approximately 222 lots had permitted conventional septic systems, and 10 of those 222 lots have converted to Type 4 general permit on-site wastewater systems (in the Summerhaven Sewage Planning Area). Of the 222 lots originally on conventional septic systems, 108 lots were reported as having fire damage/structure loss according to data provided by Pima County Department of Environmental Quality (PDEQ). Since the fires, approximately 52 Type 4 general permits have been issued for lots in the Summerhaven Sewage Planning Area.
Lot owners of the 98 remaining fire impacted lots that were previously developed and that had conventional septic system may request recertification from PDEQ of the former (pre-fire) conventional septic systems if the systems were not damaged. Old systems may not meet requirements for Type 4.0 general permits for on-site wastewater treatment systems, especially since subsurface limiting conditions may be present at the majority of the lots (A.A.C. R18-9-310(D)(2)). If the number of lots with previous conventional septic systems (222 total) are subtracted from the 679 lots in the management area, 457 lots prior to the fires were either undeveloped or had systems that were not permitted based on available records. (Pima County records indicate that a total of 600 structures were present in all of Summerhaven prior to the fires.) Exhibit 1 Mount Lemmon Septic Permit and executive summary Figure ES-4).

If the lots with permitted Type 4 systems and the lots with active connections to the current WWTF are subtracted from the total number of lots in the Sewage Planning Area, a large number of these lots are may still need either a Type 4 system or connection to the WWTF.

The lots on conventional type septic system that are located in the primary Sewage Planning Area represent the greatest potential threat to water quality in Sabino Creek. Limiting site conditions in the area may preclude issuance of Type 4 general permits for many of these lots, and these lots may potentially end of requesting connection to the WWTF, if developed.

**Ski Valley**

Ski Valley currently contains a septic system and leach field to treat and dispose of minimal seasonal waste. Due to the distance from Sabino Creek and other surface waters, any discharge of treated waste is expected to have a small effect on the Sabino Creek Watershed. If a
gravity sewer connection were to be proposed for Ski Valley the estimated
construction cost is shown in the table below. The high cost of this
conveyance may off-set the benefit of including lots in this area in the
sewage management area or a potential improvement district.

Table 7-1
Ski Valley Estimated Sewer Construction Cost

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description</th>
<th>Unit</th>
<th>Qty</th>
<th>Unit Price</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8” DIP restrained joint pipe</td>
<td>LF</td>
<td>7,400</td>
<td>$75</td>
<td>$555,000</td>
</tr>
<tr>
<td>2</td>
<td>Rock excavation</td>
<td>CY</td>
<td>4,440</td>
<td>$115</td>
<td>$510,600</td>
</tr>
<tr>
<td>3</td>
<td>Sewer manhole</td>
<td>EA</td>
<td>20</td>
<td>$60,000</td>
<td>$1,200,000</td>
</tr>
<tr>
<td>4</td>
<td>Asphalt removal</td>
<td>SY</td>
<td>3,300</td>
<td>$4</td>
<td>$13,200</td>
</tr>
<tr>
<td>5</td>
<td>Asphalt replacement (4” thick)</td>
<td>TON</td>
<td>730</td>
<td>$60</td>
<td>$43,800</td>
</tr>
</tbody>
</table>

|                | SUBTOTAL                             |      |      |            | $2,322,600|
|                | 30% contingency                      |      |      |            | $696,800  |
|                | TOTAL                                |      |      |            | $3,019,400|

Notes:
1. Rock excavation assumes a 2’ wide trench, 8’ deep and also includes drilling or
   blasting or removal by mechanical means such as a rock saw.
2. Pipe estimate includes bedding and backfill.
3. Manhole estimate assumes 1 manhole every 500 feet with 5 additional manholes
   for alignment adjustments.

Summerhaven East

The area east of Summerhaven subdivision was also evaluated for
inclusion in the sewer service planning area. Of 92 lots in this area, there
are approximately 91 large lots with approximately, of which 14 lots had
conventional septic systems prior to the fire. One of these 14 lots has
since obtained a Type 4 general permit, leaving 13 lots that had septic
systems that have not obtained permits for redevelopment. The housing
density in this area is approximately 1 home per acre; however there is a significant amount of common area that resulting in the average lot size being approximately 1/3 acre. If one of these septic systems were to fail, the homeowner should have enough space on their property to construct a new leach field or other permitted on-site disposal system (Wisconsin mound, evapotranspiration (ET) bed, advance treatment and drip irrigation, etc.), assuming other limiting site conditions outlined in the Type general permit rules were not present. However, new Type 4 GP requirements may make permitting on-site systems in this area infeasible due to site limiting conditions (such as slopes that are greater than 15%) that are defined in rule.

Although there may be lots that could be connected in this area, expanding a gravity sewer main to this area would be prohibitively expensive due to topography and distance from the existing system. A small diameter, low pressure sewer main or force main could be designed for this area to discharge into the sewer gravity main. This option would also be expensive.

The distance of many of these lots to Sabino Creek reduces the likelihood of impact from septic systems located in this area to the water quality in the Creek. So this area is a lower priority for connection than the main Sewage Planning Area. This is however, a potential area of customers, to PCWMD if conveyance were cost effective. It should be noted that only a small portion of lots in this area were previously developed.

**Summerhaven West**
The area west of Summerhaven subdivision was also evaluated for the expansion of the sewer service area. The same criteria were used for this area as the east side of Summerhaven. There are approximately 107 lots in this area, of which 10 lots had conventional septic systems prior to the fire. Two of these lots have since obtained Type 4 General Permits. The
lot sizes vary greatly, but they average approximately ½ acre. The distance from the closest property line to Sabino Creek is approximately 1,000 feet. The distance from their existing leach fields to Sabino Creek is so large that the effect on the watershed and water quality in the Creek is believed to be minimal. This is however, a potential area of customers to PCWMD if conveyance were cost effective. However, the small of lots that were previously developed suggest that redevelopment may not be likely.

The three areas described above Ski Valley, Summerhaven East, Summerhaven West are being removed from the planning area. All three areas are remote from Sabino Creek, already served by existing on-site systems (or have the ability to be served due to large lot sizes assuming site limiting conditions are not present), and the infrastructure costs required to provide service to these areas may be prohibitively expensive. Due to these factors, these three areas were not included in the recommended planning area.

The proposed sewer basin planning area is located within the Summerhaven subdivision. Some lots within this subdivision have been platted but are not likely to be built on. For planning purposes, if a lot has greater than 40% slope, the lot will be identified as an improbable construction site. It should be noted that all lots with slopes greater than 15% are technically ineligible for Type 4 general permits (on-sites) based on restrictions in rule. Exhibit 3 illustrates the sewer basin planning area for the Summerhaven subdivision with the three areas mentioned above excluded and lots with average slopes greater than or equal to 40% removed.

**WWTF Influent Expected Growth**

Predicting growth for an area is an imprecise exercise. In order to increase the chance of accurately predicting future WWTF influent flows we will look at several scenarios.
Since the Aspen Fire, influent to the WWTF has increased less than 300 GPD per year (Section 2.1). This growth rate would be considered the minimum growth expected in Summerhaven and will most likely be exceeded as new development occurs.

After the Aspen Fire, Pima County, local architects, University of Arizona, and the public worked together to develop the Mount Lemmon, Summerhaven Master Plan. A brief synopsis of this plan is shown in Appendix X. As a result of this planning effort, there are several new developments currently in planning or construction for Summerhaven that are a significant departure from past building practices.

**Summerhaven Community Center - 12949 N. Sabino Canyon Park**

Pima County has completed construction of the Summerhaven Community Center. This public facility, located at the southwest corner of Sabino Canyon Parkway and Turkey Run Lane, opened in July 2007. It contains public restrooms, a large meeting room, office and outdoor patio space. Pima County is removing the existing comfort station/public restrooms. Wastewater generated at the Community Center is expected to be approximately equal to the amount generated by the former public restrooms. Therefore, the addition of this facility is not expected to greatly increase the WWTF influent flow.

**Village Center, Phase I**

The Village Center consists of a proposed condominium complex. This development will contain 1,750 fixture units for Phase I. Their negotiated discharge permit with PCWMD restricts flow to a maximum 6 GPM, five nights per week, 10 PM to 6 AM, Sunday night through Thursday night. Wastewater discharge is prohibited during other times. Construction is expected to begin spring 2008 and is expected to be complete by spring 2009.
**Orchards**

This development consists of 16 condominiums containing 380 fixture units. This development does not currently have a connection permit yet, however it is expected that their discharge permit will have the same flow restrictions as the Village Center; 6 GPM, five nights per week, 10 PM to 6 AM, Sunday night through Thursday night. Wastewater discharge would be prohibited during other times. Construction is expected to begin spring 2009 and is expected to be complete by spring 2010.

Since the Aspen fire, the WWTF influent flow has been increasing at a rate of less than 300 GPD per year. Recently (2004-2006) the average flow per active connection is approximately 110 GPD (Table 2-1), so a 300 GPD increase per year is three or less new active connections per year. Therefore, for planning purposes, three new connections per year is a conservative number based on the past four years of influent data. It is anticipated that rebuilding in Summerhaven will continue at this rate or increase slightly.

### 7.2 Land Use

Until recently all of the property in the Summerhaven sewer planning area was developed as single family homes or as commercial property. Commercial uses mainly consisted of small restaurants, general stores, real estate offices, and gift shops. Zoning in Summerhaven is a mixture of Mount Lemmon (ML) and Rural Village Center (RVC).

RVC zoning in Summerhaven is limited to the lots immediately adjacent to Sabino Canyon Park and Turkey Run Lane, as shown in **Figure 7-1, Land Use Zoning**. RVC zoning is generally designated to provide a mixed-use village center including commercial and residential uses planned and designed for the convenience and necessity of a suburban or rural area. The regulations are designed to maintain the suburban character of the “downtown” Summerhaven
area. It is also established to provide safe ingress and egress to and from the commercial district.

ML zoning provides for a minimum lot size of 36,000 square feet, however the zoning regulations allow for smaller lot sizes for lots recorded prior to June 19, 2003. The primary permitted use of land in the ML zoning is individual home sites.

Development in Summerhaven is expected to deviate from previous practices. The Orchards, Village Center, and the Community Center are all examples of this changing environment in Summerhaven. It is expected that commercial properties and condominium units will be developed along Sabino Canyon Park Road, while individual homes will continue to be constructed on lots in the ML zoned area.

All land use options for expansion of the WWTF with new options or expanded options for disposal of treated effluent necessitate one of the following:

- access and use of USFS land by special use permit;
- acquisition of private land; or
- agreements with private land owners through a political agency, management district, right of way, easement, or other legal process.

### 7.3 Quality

This study found that since the Aspen Fire, protecting the quality of the life for the community on Mt. Lemmon has been a concern for all stakeholders on Mt. Lemmon, including residents, businesses, environmentalists and recreational users. Different stakeholders in the community have varying and sometimes conflicting goals and objectives for Summerhaven and Mount Lemmon. (Mt. Lemmon Summerhaven Master Plan in Appendix X). Local business owners wish to encourage additional visitors and residents, while some residents and environmentalists would prefer that development be limited. This study is meant
to encourage recovery of this area after the fire to restore pre-fire population, occupancy and uses. Expanding the PCWMD treatment facility and collection system enables redevelopment of Summerhaven and restores pre-fire uses by ensuring that adequate wastewater treatment facilities are in place to meet community needs and increased local population during holidays. It should be noted that encouraging redevelopment is neutral to growth. It simply supports recovery of the area and community after the fires in an environmentally conscientious matter that protects not only the land but also provides stewardship to Sabino Creek.

At the public workshop held on February 10, 2007, these diverse interests were brought together in a three-hour, interactive workshop to discuss the goals, opportunities and constraints for this study (see Workshop Summary in Appendix Y). The participants were given a brief history of wastewater management on the mountain, watershed and environmental information and project parameters, and then broke out into small groups by interest – environmental, residential/commercial and recreational – to discuss. After an hour, the participants reconvened to share their findings with the group at large.

The study team compiled the findings from the workshop, and found that the participants identified six common goals that were important:

1. Environmental soundness
2. Maximize availability of water resources
3. Public acceptability
4. Regulatory compliance
5. Financial viability
6. Provide capacity to meet demand

For each of these goals, the participants outlined possible opportunities and constraints. These goals were incorporated into the essence of this report, and responsiveness to stakeholder input was considered an objective of the study.
8.0 Management Issues

8.1 Public Involvement

A workshop was held on February 10, 2007, at Real Life Christian Fellowship located at 3353 N. Houghton Road, Tucson, Arizona. The workshop was publicized with newspaper advertisements in the Arizona Daily Star and Tucson Citizen on January 26, 2007; an announcement in the February 2007 issue of the community newsletter for Summerhaven (Mt. Lemmon Echoes); a news release sent to area media outlets on January 26, and February 6, 2007; a postcard invitation sent to Mt. Lemmon property owners, residents, stakeholders and other interested parties on January 29, 2007; circulated a notice via e-mail to interested parties in the two weeks prior to the workshop; and PCWMD staff participated in a radio interview held the day prior to the workshop.

Forty-two members of the public, twelve staff members from Pima County, five staff members from the U.S. Forest Service and nine members of the consultant team attended the workshop. The goals of the workshop were to gather input from affected and interested parties and for diverse interests to hear each other’s comments. After an overview of the project given by the study team, attendees broke out into four small groups by interest and were requested to identify goals, opportunities and constraints.

- Constraints: Features of the area, population and location that limit the options available for Pima County related to wastewater treatment on Mt. Lemmon.

- Opportunities: Unique situations that should be integrated or considered during recommendation of a final solution to wastewater issues on Mt. Lemmon.

- Goals: Overall objectives that are important to participants of the open house.
The four interest groups were recreational, environmental, residential and residential/commercial.

Most groups identified constraints and opportunities but did not have time to organize them into goals. Pima County, Gordley Design Group and EEC subsequently met to organize the comments received. A full listing of comments from each group is included in Appendix Y.

The opportunities and constraints fell into six general goals: Environmental Quality, Water Resources, Public Acceptability, Regulatory Compliance, Financial Viability and Meeting Demand. The following is a compilation of input from all four interest groups.

Goal: Environmental Soundness

- **Opportunities**
  - Create green space/re-vegetation
  - Analyze spray field in relation to burned soils
  - Standard of treatment for reclamation purposes
  - Discharge above Sabino watershed (septic tanks are discharged into Sabino Creek watershed already)
  - Create a contingency plan and a way to implement it
  - Minimize inflow into to the collection system
  - Provide support/assistance to campgrounds

- **Constraints**
  - Water quality of effluent
  - Wide range of soil conditions
  - Water quality issues caused by wildlife and other natural sources (i.e. copper and zinc)
  - Issue of erosion caused by building and fire
  - Pros and cons for sewers and septic systems
  - Properly abandon septic systems if people hook up to sewer system (property owner responsible for abandonment (fill-in, etc.))
Can the mountain handle additional people if snowmaking approved

Capacity of Summerhaven

Goal: Maximize Availability of Water Resources

- Opportunities
  - Look at entire watershed area/riparian zone
  - Analyze effect of fires on watershed areas
  - Include opportunity to use reclaimed storage tank for commercial use, possibly at the top of mountain for use at ski area, down to community
  - Incorporate public and private cooperation for reclamation of spray and discharge
  - Determine future site for spray-field; southwest side of school is a good location for spray-field
  - Discharge above Sabino watershed
  - Water from a specific watershed should stay in that watershed
  - Increase water in area through recharge and return creek flows to the way nature created them by putting water back in Sabino Creek to increase stream flow
  - Use effluent for plant irrigation or toilets
  - Create green space/re-vegetation and manage vegetation to enhance in-stream flow
  - Stabilize soils near Winkleman Avenue by using reclaimed water
  - Provide fire protection for built-up area
  - Use effluent for fire fighting
  - Provide other uses for reclaimed water
  - Maximize use of gray water in general and at each property

- Constraints
  - Standard of treatment for reclamation purposes
Water use/availability, lack of water for flushing toilets due to seasonal precipitation limits, summer – low-flow periods
- Importation of water
- Be mindful of water use and minimize it
- Expense for homeowners for reclaimed water use
- Not much irrigation use by homeowners
- Forest Service concern over additional discharge
- Snowmaking is temperature dependant, perhaps the ski area is too mild to make snowmaking a viable option
- Can the mountain handle additional people if snowmaking approved

Goal: Public Acceptability
- Opportunities
  - Increase water in area through recharge and return creek flows to the way nature created them by putting water back in Sabino Creek to increase stream flow
  - Create green space/re-vegetation
  - Stabilize soils near Winkleman Avenue by using reclaimed water
  - Fire protection for built-up area
  - Other uses for reclaimed water
  - Odor control at spray-field and treatment facility
  - Project serve all residents/selection criteria/preference for those nearest the creek
  - Make sure that there is a focus on residential needs
  - Provide consistency from property to property
  - Greater capacity – with better quality discharge (so commercial doesn’t take away from or conflict with residential)
  - Recognize the entire county’s commitment (visitor use)
  - Opportunity to use reclaimed storage tank for commercial use
o One point of contact for the Mt. Lemmon Basin
o Utilities under roadway/road maintenance
o Future site for spray-field

• Constraints
  o Public is increasingly unwilling to use dry pit latrines or compositing toilets
  o A possible requirement for all homeowners to hook up
  o Could be an additional cost to homeowners
  o Possibility of commercial interests taking away from or conflicting with residential interest in hooking up to the system
  o Can the mountain handle additional people if snowmaking approved
  o Capacity of Summerhaven in general

Goal: Regulatory Compliance
• Opportunities
  o Location and future site of spray-field
  o Remove legal restraints to discharge into Sabino Creek
  o Standard of treatment for reclamation purposes
  o Explore innovative option for disposal of wastewater and streamline the process (permitting – capacity, cost, process, timeframes)
• Constraints
  o Pros and cons for sewers and septic systems
  o Forest Service concern over additional discharge
  o Chances of state overturning rule

Goal: Financial Viability
• Opportunities
  o Public and private cooperation for reclamation of spray and discharge
o Improvement district
o Tax assessment
o Recognize the entire county’s commitment (visitor use)

o Explore innovative option for disposal of wastewater and streamline the process (permitting – capacity, cost, process, timeframes)

- Constraints
  o Who will pay for it and how
  o Limited funding for wastewater system
  o Could be an additional cost to homeowners
  o A possible requirement for all homeowners to hook up
  o Persons who can’t connect to sewer – service area line
  o Length and cost of hook-up
  o Expense for homeowners for reclaimed water use
  o Importation of water
  o Road maintenance
  o Pros and cons for sewers and septic systems
  o Property owner responsible for septic-system abandonment (fill-in, etc)

Goal: Provide Capacity to Meet Demand

- Opportunities
  o Development capacity for future needs
  o Design capacity for projected discharge from Summerhaven area
  o Analysis of lots and commercial properties for design/supply capacity
  o Greater number of hook-ups are wanted
  o Greater capacity – with better quality discharge (so commercial doesn’t take away from or conflict with residential)
  o Maximize treatment capacity/minimum requirement is the maximum use
Minimize inflow in order to maximize the capacity for treatment of wastewater
Project serve all residents/selection criteria/preference for those nearest the creek
Satellite systems for treatment facility
Explore innovative option for disposal of wastewater and streamline the process (permitting – capacity, cost, process, timeframes)

Constraints
Density changes
Timing and phasing of system expansion if that’s what’s chosen/allowed
Possibility of commercial interests taking away from or conflicting with residential interest in hooking up to the system
Persons who can’t connect to sewer – service area line
Pros and cons for sewers and septic systems
Capacity of Summerhaven
Campground cannot connect to Forest Service lagoon because lagoon is at capacity and is uphill from camps

Subsequent to the public meeting, Pima County received additional correspondences related to the issues discussed. Copies of these correspondences are included in Appendix Y.

8.2 Revised USFS Permit
As part of planning, EEC met with USFS representatives to discuss the current amended Special Use Permit and its status in relation to future options. At the time a new or expanded WWTF comes on line with increased flows, a new or amended special use permit needs to already be in place to allow discharge to start for the increased flows and revised plant operations or to new areas. Issues associated with this option are discussed in Section 3.0.
Based on planning and CIP information presented in Section 9.0, an upgraded WWTF is recommended to come on line in 2011. The current USFS SUP is based on not only specific discharge limits, but also a plant with a specific design and capacity. A letter requesting amendment to the current SUP directed to the USFS District Ranger will start the process. Since the upgrade/replacement proposed for 2011 is aimed at improving WWTF effluent quality, this process can be handled through letter amendment based on 30-60% design plans which will be available in May of 2009 based on the schedule in Section 9.0.

Storage Tank – The storage tank proposed for the area by the old sawmill and current heliport pad may qualify for a categorical exclusion. The NEPA process needs to start with a request and initial site screening and scoping and a request to the USFS District Ranger.

Sabino Creek Outfall - To discharge to Sabino Creek, PCWMD will need to initiate the NEPA EIS scoping process. This process starts with scoping and continues through the EA and EIS stages.

Reclaimed Irrigation Areas – This process needs to start with site screening, baseline studies and scoping as part of NEPA. It is possible that this use of USFS land may only need an EA if the area proposed for use is already cleared and there are no threatened and endangered species issues. PCWMD may also request that the District Ranger assess if this use may qualify for a Categorical Exclusion, since it is proposed as post fire recovery and rehabilitation and will result in reforestation and stabilization of soils.

8.3 Service Area Boundaries
Exhibit 3 shows the sewer basin planning area. It has been clear during preparation of this report that the area shown on this exhibit is not a sewer service area. Pima County has stated unequivocally that this is a planning area and not a service area. Pima County has adopted a “developer neutral” approach to wastewater management on Mt. Lemmon. In general, PCWMD will
treat wastewater if the developer builds the conveyance system to PCWMD’s standards and the treatment facility has the capacity to accept the flow. Therefore, the service area boundaries are generally the overall area in Exhibit 3.

8.4 Facility Features (Location, Size, Type)

This report recommends the construction of a new WWTF at the site of the current plant. The recommended treatment option is a 50,000 gpd SBR system utilizing the existing sludge holding tank and integrating a new belt filter press for sludge thickening. In addition the effluent would need to be filtered and disinfected using a UV system, and a copper and zinc removal system may also be required. The SBR layout shown in Figure 5-5 provides for an expanded treatment capacity with odor, noise, and required facility setbacks.

By constructing the new plant adjacent to the current facility the phasing of the construction can be easily accomplished, leaving the current plant in operation. To accomplish this, a new influent pump station would need to be constructed possibly down stream of the current influent pump station. The new influent pump station should be sized in such a way that it can be used for flow equalization into the new plant; thus handling the weekend vs. weekday fluctuations in sewer flow into the plant. By doing this all of the new process equipment could be installed during construction without impacting the current facility’s operations. When the construction is complete a new diversion manhole ahead of the current influent pump station can divert the flow of wastewater into the new influent pump station.

Once the new treatment process goes online the current plant can be used any number of ways. The tanks within the current facility can be used for flow equalization, sludge handling, or even grit removal. However, because of the current set back requirements the current facility with the exception of the sludge holding tank cannot be utilized for the treatment process without acquiring additional property to the north of the plant. This is due to the fact that half of the
current plant is located within the 50-foot setback required for a new sewage treatment facility larger than 24,000 gallons per day.

If the prohibition for discharging treated effluent into the Sabino Creek watershed is lifted then the effluent can be discharged into the Carter Canyon drainage way located on Pima County’s property. In addition the effluent can also be used for reforestation or for fire fighting utilizing an effluent holding tank near the fire station located at the West Sawmill site north of Summerhaven.

**8.5 Discharge/Disposal Method(s)**

Disposal options determine which additional permits and regulatory program requirements may apply and drive whether special design requirements may be needed. The options considered in the matrix were:

- Continued use or expanded use of the current spray field and AZPDES outfalls in the San Pedro Watershed;
- total reclaimed use for reforestation using native trees such as aspen and white fir that have limited but some uptake water in the winter and other reclaimed uses such as use of water for fire-fighting;
- recharge of treated effluent in recharge wells to obtain Arizona Department of Water Resource (ADWR) credits; and,
- discharge to a new outfall in Sabino Creek (assuming the prohibition in rule can be revised).

Of these options, total reclaimed use and firefighting water supply are reclaimed options and are addressed in Section 8.6.

**Use of the Current Spray Field**

The benefit of this option is that a special use permit is still in place for monthly average flows up to 12,500 gpd, a new piping system would not be needed to convey the effluent from the plant site to the spray field and costs associated with construction of the expanded spray field are likely to be low. Further although this option is disposal in the watershed and allows discharged treated effluent to
percolate which may recharge in the subsurface, the recharge is occurring in the San Pedro Watershed, not the Sabino Creek Watershed.

The regulatory impacts of this expanding this option which relies on a Special Use Permit for USFS land may have challenges to the project timeline and other project objectives which are discussed further in Section 3.1. These pertain to the NEPA process and timelines which may extend up to 2 years if there is not a Finding of No Significant Impact (FONSI) at the EA stage or if a Categorical Exclusion does not apply.

**Recharge to Groundwater Through Injection or Basins**

The quality of the effluent for an expanded plant will be required to meet new facility BADCT treatment performance standards. Therefore the quality of the effluent proposed for recharge should meet numeric AWQS for all constituents at the end of pipe. A detailed hydrologic study would be required for a recharge/injection project, including exploratory borings to establish subsurface properties and determine appropriate recharge well design.

The downside of this option is that it requires two additional permits to be obtained: an ADWR recharge permit in addition to the aquifer protection permit, and USEPA underground injection control (UIC) permit. Depending on the quality of effluent or potential USEPA concerns for other water bodies, the pathway for obtaining approval for injection could be complicated and take up to 2 years. It is also important to note that due to limited land availability, the adjacent Pima County parcel may be the only option for location of recharge wells and there is very limited property available. Further outcrop of impermeable bedrock further restricts the feasibility of this option.

Given that bedrock is shallow beneath the ground surface, vadose zone treatment would not be offered by the subsurface prior to treated effluent reaching fractures in bedrock and it is unlikely that the underlying gneiss and granite will receive injected/recharged wastewater – to even assess this would
require an extensive and expensive study to find open fractures. Demonstration of compliance with discharge standards would be required at the point of discharge. Hydrologic studies associated with this option may be substantial to prove that there is no communication or day-lighting of treated effluent through hydrologic connection to the nearby Sabino Creek, which is located approximately 200 feet from the WWTF site or possibility of impact to the local water supply system. ADEQ and possibly EPA will require compliance with discharge standards at the point of injection. If EPA requires an individual UIC permit, the injection point would be identified as a point of compliance. However, since the hydrologic system is not well understood and there are wells located within ¼ mile of the WWTP which may be used for domestic water supply, it is possible that in addition to end of pipe standards, if groundwater is found to be present in fractures, groundwater monitoring wells will be required by ADEQ to demonstrate compliance with Aquifer Water Quality Standards (AWQS) in the uppermost aquifer beneath the facility and to address hydraulic connection concerns. In a hydrologic setting where groundwater flow is driven by fracture patterns, alluvium in drainages, and bedrock outcrop, numerous wells may be needed for permitting and cumbersome and costly monitoring requirements are likely. Given the perception of potential hydraulic connection between shallow groundwater and Sabino Creek and concerns relating to day-lighting of treated effluent, to pursue this option the County would simultaneously pursue lifting the prohibition on discharge to Sabino Creek.

However, EEC does not recommend that recharge or injection be carried forward as a feasible option given uncertainties in success and the high cost of hydrologic studies which would be necessary to even assess whether this option would work.

**Discharge to New Outfall in Sabino Creek**

In order for this option to be feasible Pima County would need to aggressively pursue a rule revision to lift the prohibition in A.A.C. R18-11-123(A). PCWMD
can petition ADEQ for this rule revision, but the next opportunity for triennial review of the SWQS rules is in 2010. This means that if successful, the revised rule might not be in place until 2011 or 2012, depending on the timeline of the rule making process, which has the potential to take more than one year once a docket is opened. In general the community appears to support this option based on community meetings held to date. Although there are endangered species living in Sabino Creek, interactions with Federal agencies suggest that a year round baseflow from the WWTF may have a positive effect on the environment for these species, assisting in their survival and growth, rather than a deleterious effect.

This option would require both APP and AZPDES permits, and given that Sabino Canyon is located in Coronado National Forest, the USFS has stated that NEPA requirements will also come into play also. At the minimum an EA would be required which is estimated to cost in excess of $500,000.00.

This option includes public involvement and exposure during two public comment periods for the APP and AZPDES permits and, if triggered, also multiple public input opportunities during the NEPA process. While public involvement is important, if the project is not embraced, these processes may also affect project outcome and the project timeline. If pursuing this option, given the possible response during the rule making process and public comment periods, in order to meet growth projections and flow projections which suggest capacity will need to be expanded as soon as 2012 to meet peak flow needs. Therefore, pursuit of a parallel disposal option(s) is be recommended. This is also suggested in case either PAG or ADEQ to not embrace the concept of renewed discharge to Sabino Creek, even with improved discharge quality from interim upgrade.

As a part of assessing the feasibility of this option, EEC compiled effluent data for the Mt. Lemmon WWTF and computed SWQS for Sabino Creek using the effluent data and data from samples of Sabino Creek that were collected in December of 2006 and March of 2007. This exercise indicated that the current
WWTF is not producing effluent quality that would meet current SWQS that would apply for Sabino Creek and additional treatment would be needed for this discharge option to be feasible, unless the creek is classified through rule revision as an effluent dependent water. In assessing the standards, EEC used December 2006 and March 2007 pH, temperature and hardness data from samples collected in Sabino Creek to calculate SWQS. Although after discharge of treated effluent to the creek ADEQ may consider the creek an effluent dependent water (EDW), to be conservative EEC calculated the standards as using receiving body characteristics (as a non-effluent dependent water) and then assessed performance of the current WWTF in comparison to the standards. Based on limited review, current effluent quality appears to exceed current SWQS for Sabino Creek for the following constituents: total residual chlorine; ammonia; nitrate; nitrite; nitrate-nitrite; copper; total cyanide; zinc; bisphthalate; chloroform; and, total trihalomethanes. For success in lifting the prohibition and meeting standards, an upgraded WWTF capable of producing effluent that meets BADCT treatment performance standard discharge quality would be needed. Further it is possible that either additional treatment or reduction of sources of copper and zinc in influent may be needed for success with this option, given the elevated concentrations of these two metals in current WWTF influent.

Between the timelines required for rule revision and permit issuance and construction of an upgraded WWTF with the current capacity or expanded WWTF with increased capacity, it is important to note that discharge to Sabino Creek is not a realistic option to achieve to address peak flows that may result from projected growth that is expected to occur in the 3 to 5 year timeframe. But this is a feasible option for longer term planning, based on the growth projections presented in Section 7 and 8 of this report and the schedule which was developed from the pathways figure at the end of in Section 3.0.
Discharge from the PCWMD Mt. Lemmon WWTF is currently prohibited from entering the Sabino Creek Watershed by both environmental rule and also the current amended 208 Certified Area-wide Water Quality Management Plan. Until such time as the restriction is removed from the 208 plan and this rule is revised to remove the prohibition, PCWMD cannot develop an outfall near Summerhaven in the Sabino Creek Watershed and in the short term must rely on the current spray field in the San Pedro Watershed. In the best case scenario, this rule could be reversed as early as 2011. Then PCWMD could begin permitting required to discharge properly treated wastewater to the Sabino Creek Watershed. However, in order to discharge to Sabino Creek, PCWMD would have to obtain an AzPDES permit, APP, USFS special use permit, and perhaps and at a minimum an EA and possibly an EIS. There are many areas where the process could get stopped or delayed in the EA or EIS process. This option has been carried forward as feasible, and timelines associated with permitting have been incorporated into the timeline for implementation of this project.

This study recommends that a combination of options be pursued for the Mount Lemmon WWTF and that disposal options be coupled with reclaimed options identified below. The primary disposal options recommended from by this study are: continued use of the current spray field until 2022 and then use of it as a contingency, as needed after; and, development of an outfall to Sabino Creek assuming that the 208 plan is amended and the rule prohibiting discharge revised to allow this option.

Recharge and injection are not recommended for disposal of treated effluents due to costs and uncertainties associated with the local geology, and the occurrence of sensitive springs which are the primary source of drinking water.

### 8.6 Reclaimed (Reuse) Options

Effluent from the Mt. Lemmon WWTF could be utilized for a wide range of potential projects. The Environmental Protection Agency has established the following categories for the reuse of wastewater effluent:
• Habitat Restoration/Enhancement
• Recreational Reuse (snowmaking)
• Urban Reuse for landscape Irrigation and Firefighting
• Agricultural Irrigation
• Industrial Reuse (no industrial uses are present in the management area)

Among these possible reuse methods, the study area could readily support habitat restoration (as discussed below), and urban reuses (such as landscape irrigation, included in reclaimed use below). The area does not have the agricultural or industrial components to support reuse by these entities.

**Total Reclaimed Use of Treated Effluent - Irrigation**

The various regulatory program impacts on the WWTF and disposal options are discussed later in this section. In general, if total reclaimed use can be put in place and consumptive use demonstrated using standard models such as Blainey-Criddle, then application/irrigation areas will be considered non-discharging under both APP and AZPDES programs even during winter months. In this scenario an AZPDES permit would not be required, assuming the irrigation area is properly designed to prevent ponding and runoff. If sufficient irrigated acreage can be obtained for the rate of uptake by either aspen or white fir (or another equivalent native tree or plant that takes up water in winter freezing conditions), then models can be used to successfully show that reclaimed water will be taken up by the irrigated areas. If irrigation is performed at true consumptive use rates, this is a demonstration that there is no reasonable probability of discharged effluent reaching Sabino Creek (in the event that the prohibition of discharge is not successfully lifted through a request for rule revision). In this scenario, neither an AZPDES nor APP permit is required for the irrigation area, only for the WWTF. APP requirements relating to reclaimed classification and reclaimed quality monitoring would be put in the individual APP for the WWTF. A reclaimed permit (or permits) would still be required, but the timeline for obtaining reuse permits is relatively short (6 months generally) compared to other permitting options. Preliminary assessment suggests that the engineering viability and economic viability of this total reclaimed use is worth
exploring. Depending on what land is used for this option – private or National Forest – the NEPA process may or may not be involved. Performing reclaimed irrigation with consumptive use on private land will not require a NEPA process.

**Watershed Recharge/Reclaimed Use through Snowmaking**

There has been significant support by the USFS, USFWS, and the local community regarding watershed recharge. The general consensus from meetings with these groups is that they would prefer returning properly treated effluent water to the Sabino Creek watershed. As discussed above there are significant regulatory hurdles to overcome prior to planning any discharge to the Sabino Creek watershed.

One possible way that effluent could be indirectly recharged to the Sabino Creek watershed is via snowmaking at the ski area. Arizona Snowbowl (Flagstaff, Arizona) has so far been unsuccessful in their attempt to use reclaimed water for snowmaking and has met with significant resistance from the public.

To combat the lack of snow and assist with an expansion of facilities, Arizona Snowbowl proposed using reclaimed water for its artificial snowmaking to establish the required ski base. ADEQ reclaimed water regulations authorize snowmaking with Class A reclaimed water, a designation of water quality that is more than met by Flagstaff treatment facilities. Intrigued by the innovation suggestion to make use of reclaimed water in winter months (normally a low demand period) and the opportunity to improve the local economy, Flagstaff agreed to provide reclaimed water to Snowbowl.

Because the proposed use is on USFS land, an Environmental Impact Statement (EIS) was required and performed. USFS issued a Record of Decision (ROD) on the EIS in February 2005, and indicated the use of reclaimed water for snowmaking was acceptable. However, concerns tied to the cultural significance of the Peaks for 14 Native American tribes has fueled controversy over the proposal, and has extended into the Flagstaff community at large with respect to concerns about trace amounts of endocrine disrupters in the treated water and their potential impacts on the environment and human health.

The ROD by the Forest Service was appealed, but was affirmed by the Southwest Regional Forester. The decision was challenged in the Prescott District Court in 2005. In January of 2006, a judge issued a
decision upholding the Forest Service decision to permit snowmaking. The judge’s decision has been appealed to the Ninth Circuit Court of Appeals in San Francisco. The appeal was heard in September 2006. The agreement between the City of Flagstaff and Arizona Snowbowl is for 20 years with a renewal that will take place every 5 years. The agreement was due for renewal by March 2007 and was renewed “administratively”. A subsequent protest was held at the January 2007 Water Commission meeting. As of March 2007, a decision from the Ninth Circuit Court of Appeals has been issued. It is assumed that opponents of the project will continue on to the Supreme Court if the Forest Service decision is still upheld.

Source: AWPCA April 2007 Newsletter

Use of reclaimed water for winter snowmaking was put into the matrix as an option. In order to use water for snowmaking reclaimed use, it must be treated to A reclaimed standards in accordance with A.A.C. R18-11-309, Table A. Without lifting the prohibition of discharge to Sabino Creek, realistic consideration of use of reclaimed water for winter snowmaking is likely to rely on two hydrologic studies that may have substantial cost. Given that the ski area is located in the watershed to Sabino Creek, springs are present in the area, and shallow fractured bedrock is present, a thorough hydrologic study is needed to show there is no hydrologic connection between the application area at the ski slopes and the creek. While this hydrologic study could include gathering of existing geologic and hydrologic data, exploratory borings, wells and cross sections are probably needed at key locations to assess depth to bedrock, fracturing and the possibility of hydrologic connection with the creek (or to simultaneously pursue lifting the prohibition on discharge to Sabino Creek). It should be noted that the MLWID water supply comes from shallow horizontal wells that are in the vicinity of the ski area. Therefore studies regarding use of reclaimed water for snowmaking would need to assess potential for impact of snowmelt on surface water runoff and water collection systems.

Even if the demonstration is successful and it can be shown that there this activity will not result in runoff from the snowpack or inadvertent discharge to Sabino Creek from subsurface hydrologic connection, there is a negative public
perception associated with use of reclaimed effluent for snowmaking that would need to be overcome. Given the extent of human contact, even though consumption is not likely, the public to date has not embraced this option. Proposals for this at Snowbowl in Flagstaff have not been successful, have been costly, and have been blocked by significant public response. A large faction of response for use of reclaimed water at Snowbowl came from tribal nation reaction to use of sacred lands at San Francisco Peaks for disposal of wastewater. This reaction occurred in spite of studies which indicated that a large part of the artificial snow created from reclaimed water would be lost to evaporation. It should be noted that Tribal Nations have already contacted the USFS Coronado Forest personnel to express concerns over snowmaking at Ski Valley.

Hydrologic studies to assess evaporation and snowpack would be needed in support of this option at Mount Lemmon to show that runoff will not occur from application areas, especially since the ski area at Mt. Lemmon is located within the Coronado National Forest and the community water supply comes from shallow subsurface collection systems. NEPA requirements will apply for this use of reclaimed effluent on National Forest land. NEPA will involve tribal consultations, and possibly cultural resource surveys and State Historical Preservation Office (SHPO) interactions. This increases project exposure and may result in adverse response from the community. This possibility should be weighed heavily in evaluating this as a realistic option for disposal of wastewater from the Mt. Lemmon WWTF.

Given numerous issues associated with this option, although it was considered it was not carried forward as a recommended option.

**Habitat Restoration / Enhancement and Recreational Reuse**

Habitat restoration/enhancement and the creation of recreational facilities suitable for hiking, bird watching and fishing represent potential means of effluent utilization in the Mt. Lemmon area. The quality of water that can be discharged
from the WWTF would be suitable for all of these activities. The burned areas of the forest could provide an ideal and cost effective location for habitat restoration project.

**Urban Reuse**

Widespread distribution of treated effluent for irrigation and commercial uses would require the construction of a separate distribution system. Separate effluent distribution systems are expensive to construct, particularly for services extending to individual homes. The Mt. Lemmon area currently has no large turf areas that could be irrigated with reclaimed water. However if a distribution system was constructed to individual properties then treated effluent could be used for toilet flushing, private irrigation for landscaping and fire protection using stored treated effluent. At the first community meeting, stakeholders expressed an interest in private use of reclaimed water for landscape irrigation. To implement this will require screening of private site alternatives based on a set of selection criteria and forming legal agreements for this exchange of water and a conceptual plan for reclaimed permitting, such as PCMWD becoming the Reclaimed Agent and individual homeowners that desire receiving reclaimed water for landscape irrigation to grow trees obtaining the general reclaimed permit and also forming an agreement for sustained use with PCWMD. To realistically develop private utilization will require a conveyance system from either the storage tank or the WWTF – which means areas where this could be carried out may be limited to areas that are in a short distance of the tank or WWTF. Otherwise cost of conveyance would be prohibitive given the steep terrain.

**FireFighting**

The beneficial use of reclaimed water for firefighting to reduce reliance on potable water for this use is an important recommendation. For firefighting in the area, water is currently trucked up the mountain from potable water supplies. Development of a 100,000 gallon storage tank site near the fire station and
designing this tank for helicopter access will allow a ready supply of water for fire-fighting. This option has been carried forward as a final recommended option.

**Potable Water**

Although plant upgrade and plant expansion will both result in A+ reclaimed water which is very high quality, the treatment upgrades explored by this report to not achieve a full potable water quality. Further current rules do not yet embrace potable supply as a reclaimed use. Direct reclaimed use for potable supply is prohibited by A.A.C. R18-9-704 (G)(2)(a).

Therefore, this report is NOT recommending reusing treated effluent as a potable water source, however it is important to note that other communities are moving in this direction. Cloudcroft, New Mexico has been faced with a water shortage due to recent drought conditions. The community is spending $2M to construct a 100,000 GPD water reuse system which will use an advanced treatment process to treat the water to drinking water standards. The system will consist of a membrane bioreactor and reverse osmosis system. Cloudcroft will mix the highly treated wastewater with spring water and well water and then process the water with an ultrafiltration system and chlorination, prior to being distributed to customers. This option may be explored at a later date after initial WWTF upgrade has been performed and actual flows compared to projections developed for this report and may become of further interest if the sustained period of drought continues.

This study recommends carrying forth two primary reclaimed uses and one secondary one: reclaimed use for consumptive use irrigation of developed reforested areas; reclaimed use for firefighting; and if conveyance systems can be developed, areas identified and agreements formed, possible auxiliary development of residential landscape irrigation uses.
8.7 Flow Projections

Maximum Build Out

There are approximately 495 lots within the planning area that do not have known permitted or grandfathered septic systems. Of the 495 lots there were 28 that had standing structures after the Aspen fire. These 28 lots must either have operational septic systems or connections to the Mt. Lemmon WWTF. Approximately 14 additional lots of the 495 have known connections to the WWTF. That leaves approximately 450 lots (495 – 28 – 14 = 453) that have not been improved and do not have facilities for wastewater treatment, either on-site or via PCWMD. If all of these lots were improved and connected to the WWTF, the additional flow to the treatment facility would be approximately 67,500 GPD (450 lots x 150 GPD per lot = 67,500 GPD). For 2006, The WWTF had an average influent of 2,200 GPD and the expected maximum flow from known development in the Summerhaven area is 4,200 GPD. Therefore, an upper limit on the WWTF influent is approximately 74,000 GPD.

<table>
<thead>
<tr>
<th>Wastewater Source</th>
<th>Flow (GPD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing WWTF Influent</td>
<td>2,200</td>
</tr>
<tr>
<td>Village Center Phase I</td>
<td>2,100</td>
</tr>
<tr>
<td>Orchards</td>
<td>2,100</td>
</tr>
<tr>
<td>Future Build Out</td>
<td>67,500</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>73,900</strong></td>
</tr>
</tbody>
</table>

We do not expect to see this area built out during the planning horizon of this document (20 years) for the following reasons:

- Many of the structures currently under construction are replacement buildings for structures damaged or destroyed during the Aspen fire. These are the properties that are easiest to build and already have all weather access, relatively flat slopes and other utility services.
Many of the properties on Mt. Lemmon have never been improved and may be held as investment properties for many years.

If possible, property owners would likely build alternative on-site wastewater treatment systems rather than connecting to the collection system.

PCWMD has established that their goal in Summerhaven is to be developer neutral. During the development of this report, PCWMD has indicated that:

- They will not maintain collection systems less than 8 inches in diameter; and will not maintain House Connection Sewer (HCS) lines.
- If a developer (or group) constructed conforming sewer lines that would meet all PCWMD standards, then PCWMD could accept and maintain those lines.
- Private lift stations would have to be constructed to County standards and be maintained by individuals and would require an Industrial Wastewater Control (IWC) permit to connect to PCWMD’s collection system.

PCWMD is treating this planning area similar to other service areas in the County. Developers are responsible for constructing adequate sewage conveyance facilities to deliver new flow to the existing conveyance facility. Because of the rugged terrain, shallow groundwater, paucity of soil, and generally difficult construction environment, the cost of constructing conveyance facilities is generally expensive and will be a deterrent for developers wishing to connect to the PCWMD collection system.

Erin Boyle, Assistant Forest Planner for the Coronado National Forest, provided EEC with a section of her draft master’s thesis that provides detailed information regarding surface water sources and water rights for the Mount Lemmon area (Boyle, 2007) (Appendix H). The draft report estimates, through a different methodology than those used to develop permit peak flow limits, that maximum water usage in the Summerhaven area at build out would be approximately 19 acre-feet. This coincidentally equates to an
average water usage of 17,000 GPD. The wastewater discharge would be less than the water usage.

- The limited availability of water at Mount Lemmon is a strong factor limiting growth and development and should be considered in all future planning discussions and implementation of this plan.

**Known Development Plans**

Known major developments in the Summerhaven area include the Village Center, Phase I and the Orchards. As discussed in Section 7.1, at build out these developments will add 2,100 GPD per development.

The Summerhaven Community Center opened on July 20, 2007. It is anticipated that this Pima County facility will not significantly change the amount of wastewater entering the Mt. Lemmon WWTF.

**Community Rebuilding and Growth**

Since the Aspen fire, the WWTF influent flow has been increasing at a rate of approximately 300 GPD per year. This translates into approximately three new connections per year.

As Summerhaven rebuilds, it is anticipated that the flow volume per connection will increase. A typical wastewater flow for a home built in Tucson is approximately 240 GPD.

\[(85 \text{ GPCDx}2.8 \text{ people per home} = 238 \text{ gallons per home per day})\]

EEC and PCWMD discussed realistic ranges for planning purposes and agreed that for the purpose of this study new connections to the WWTF will be modeled at an average flow of 150 gallons per day. It is expected that the existing active connections will continue to discharge flows similar to historical volumes (110 GPD) while new connections will discharge closer to the 150 GPD.
Comprehensive Flow Projections

Figure 8-1 shows influent predictions for the Mt. Lemmon WWTF. This graph shows historical flow data since the summer 2003 Aspen Fire as well as projections for known development plans and community rebuilding and growth.

Peak Flows

Tables 2-1 and 2-2 demonstrate the historic peak flows that occur at the WWTF. These peaks are generally experienced during weekends and summer holidays.
Figure 8-1: Mt. Lemmon WWTF Influent Flow Predictions

- Orchard
- Village
- Linear Growth (450 GPD/Yr)
- Existing Flow

Thousands Gallons per Day
The highest peak experienced in 2006 was during the Labor Day weekend when flows between Saturday and Tuesday averaged 2.9 times the average day flow. The highest flow during the weekend was on Sunday when flows were 3.2 times the average daily flow. Overall flows during the summer were approximately 40% higher (1.4 times) than the average flow for the year. These peaks are significant as they will challenge the treatment capacity of the WWTF first. However, if PCWMD has sufficient influent equalization volume these peaks can be leveled out and metered into the system during periods of lower flow.

### 8.8 Demand Management

As identified above, the first strain on the Mt. Lemmon WWTF is expected to be peak summer, weekend and holiday flows. PCWMD has an existing 8,800-gallon influent holding tank to help dampen these peaks. PCWMD has required two new condominium units to provide flow metering to assist with the peaks at the treatment system.

Other possible methods of managing the amount of wastewater generated by property owners include:

- Public education about water conservation through signage, water user mailings, and articles in local paper
- PCWMD could provide free or reduced cost low flow fixtures to consumers.
- Increased user fees based on potable water usage
- Increased fees for new connections
9.0 Capital Improvement Plan

The following capital improvement plan (CIP) summarizes the improvements to the sewage conveyance, treatment, reclamation and disposal facilities operated by Pima County Wastewater Management System. The information included below has been presented earlier in this report and is summarized here to provide a concise CIP for execution (Figure 9-1, CIP Project Timeline). This Gantt chart shows regulatory requirements as well as design and construction of capital improvements.

9.1 Service Conveyance System

At this time, PCWMD does not have plans for financing the expansion of the sewer conveyance system on Mt. Lemmon. The existing gravity collection system is sufficient to handle expected flows through build out. Extensive discussions have been held concerning whether PCWMD would finance sewer construction for new and home construction in the Mt. Lemmon area. It was the conclusion that PCWMD will remain developer neutral. As in other areas of the County, PCWMD will allow future connections to the collection systems, however developers and new home construction will have to provide the connections and PCWMD will take ownership and maintain the new systems.

- If a developer (or group) constructed conforming sewer lines that would meet all PCWMD standards, then PCWMD could accept and maintain those lines.
- PCWMD will maintain, construct, or own gravity collection systems 8 inches or more in diameter; PCWMD will not maintain collection systems less than 8 inches in diameter; and PCWMD will not maintain House Connection Sewer (HCS) lines.
- Private liftstations would have to be constructed to County standards and be maintained by individuals and would require an IWC permit to connect to PCWMD’s collection system.
- Two locations that Pima County may be willing to maintain and perhaps even construct (depending on the results of this study) would be located on Carter Canyon road and Turkey Run road.

Therefore there are no CIP elements identified related to the sewer conveyance system.
9.2 Wastewater Treatment/Reclamation Facility
The first modifications to the WWTF will include construction of an 50,000 gpd SBR system utilizing the existing sludge holding tank for sludge thickening and addition of a sludge belt filter press. This upgrade will result in a plant suitable for water reclamation.

The next facility upgrade will include ion exchange and reverse osmosis to remove zinc and copper from the facility effluent to improve quality for discharge to Sabino Creek to meet surface water quality standardszinc.

9.3 Effluent Discharge and Reclaimed Systems
The CIP includes designing, permitting, and constructing an effluent storage tank to provide water for emergency fire use. The effluent storage tank should be located at a higher elevation than the booster pump station so excess effluent can flow by gravity out of the tank. This site should be designed to allow helicopter water loading during extreme fire events. This storage tank will provide future opportunities for consumptive reuse of the water in the Mt. Lemmon area. USFWS has expressed interest in allowing PCWMD to use properly treated effluent for reforestation of areas. This consumptive reuse is the simplest process for extending the life of the existing USFS special use permit limit and will allow time for other regulatory options to be pursued.

A more permanent and more flexible effluent discharge system involves discharging to the Sabino Creek or its tributaries. The CIP includes this process however it cannot be assumed that PCWMD will be successful in achieving direct discharge of wastewater effluent to Sabino Creek. The process is a long public process involving many environmental studies and clearances.

9.4 Biosolids Disposal
The capital improvements associated with the options discussed in Section 5.3 and the costs discussed in Section 4.4 include both gravity thickening in the sludge handling tank, and then dewatering the sludge via belt filter press for an
estimated capital cost of $125,000. The exact equipment, its size, cost, and configuration are a function of the treatment process chosen. Hauling equipment for any disposal option can be purchased, leased, or the function can be subcontracted.

9.5 Evaluation of Concepts
The concept proposed by this report includes the following chronological CIP elements. The figures referenced after each element are process diagrams, site diagrams and cost estimates.

1. Design and construction of a 100,000-gallon effluent holding tank at the old Sawmill Site. (Table 5-9 and Figure 5-10)

2. Replacement of the existing WWTF with a new 50,000 GPD SBR and improved biosolids thickening (Figures 5-4, 5-5 and Table 5-6).

3. Design and construction of a 70-acre reforestation site near the old Sawmill Site (Figure 5-10).

4. Sabino Creek Discharge – Construction of a short pipeline from the treatment facility to the creek or its tributaries and an ion exchange system for removal of copper and zinc.

9.6 Plan Implementation Schedule
Figure 9-1 (Project Timeline gantt chart) illustrates the recommended plan for upgrades and expansion to the Mt. Lemmon WWTF, collection system, and disposal system with associated costs broken down by PCWMD fiscal year. Costs are presented in Figure 9-2 (at the end of text)

The recommended Capital Improvement Plan is broken down into the major activities (Design, Construction, and Regulatory Activities) described below:

1. WWTF Upgrade/Replacement and Reclaimed Use Options – This CIP elements consists of permitting, design and construction of a 100,000-gallon effluent holding tank at the old Sawmill Site near the fire station, replacement of the existing WWTF with a new 50,000 GPD SBR and
improved biosolids thickening by the use of a gravity thickening tank and a belt filter press.

a. Effluent Storage Tank Design - Design is estimated to be $50,000. This cost would include survey, design drawings, and bidding services.

b. Effluent Storage Tank Permitting – The approximate permitting cost would be $10,000 assuming this project receives a categorical exclusion from NEPA regulations.

c. Effluent Storage Tank Constructions – Construction is estimated at $209,000. A detailed cost estimate for this item are presented in Table 5-9.

d. WWTF Replacement and Biosolids Processing Design – Design is estimated to be $350,000. This cost would include survey, design drawings, and bidding services.

e. WWTP Replacement and Biosolids Processing Permitting – The approximate permitting cost would be $50,000

f. WWTP Replacement and Biosolids Processing Construction – Construction costs have been estimated to be $3,400,000, while the costs for upgrading the biosolids processing is estimated at $125,000. Detailed costs for these items are presented in Section 5.0

2. Reclaimed Water Reforestation – This CIP element consists of permitting, design and construction of a 70-acre reforestation site near the old Sawmill Site. Constructed elements includes: seedlings, monitoring and irrigation system controls, irrigation distribution piping and emitters. This CIP element does not include costs for an additional tank that would be required if PCWMD chooses to perform reforestation at the Carter Canyon Site.
a. Design - Design is estimated to be $75,000. This cost would include survey, design drawings, and bidding services.

b. Permitting – Permitting cost is estimated to be approximately $300,000.

c. Construction – Construction is estimated at $325,000. A detailed cost estimate for this item are presented in Section 5.0.

3. Sabino Creek Discharge – This CIP element consists of work necessary to discharge treated effluent directly to the Sabino Creek or its tributaries.

a. Regulatory Compliance, Studies, and Data Collection – This line item includes performing a complete EIS as required by the NEPA process, including installation of a gauging station, weather station and biological surveys for threatened and endangered species in Sabino Creek for NEPA.

b. Design - Design is estimated to be $20,000. The design would include a short pipeline from the treatment facility to the creek or its tributaries and an ion exchange system for removal of copper and zinc.

c. Construction – Construction is estimated at $40,000. The WWTF is located near the Sabino Creek so construction of this outfall would be a fairly small project. This capital cost includes installation of a for a fixed-bed column ion exchange treatment system to remove copper and zinc from the effluent prior to discharge.

4. Increase WWTF Permit Limit – The WWTF will already be upgraded by the time this CIP event occurs. The physical treatment plant will already be in operation as an SBR that will have the ability to treat 50,000 GPD. This element includes meeting regulatory requirements to allow PCWMD to operate the facility at the higher discharge rate (increasing flow limits set in individual permits and USFS special use permits if needed).
10.0 Findings and Recommendations
This report is a conceptual 20-year planning document. Recommendations are presented in this report based on information known at the time the study was performed and available records. Additional research and studies are recommended to refine the recommendations after this report is final. The final capacity of the WWTF, the timing of upgrade or replacement of the WWTF, the status and financing for expanding the conveyance system, and final selection of discharge options all depend on Pima County decisions and input of the community and key stakeholders. This document should be considered as a conceptual plan intended to facilitate decision-making and discussions. Implementation of this study will require additional steps including design, construction, permitting, regulatory negotiation, and baseline studies.

The current Mount Lemmon WWTF has served the Summerhaven Community for more than 20 years and operates within applicable regulatory limits. While there are approximately 878 lots in the community, many of the lots cannot be developed due to steeply sloping terrain. Pima County records suggest that about 600 lots were developed prior to the fire. Only a portion of the lots were developed for year round occupancy. Many were developed with small cabins for weekend and seasonal use. While a portion of the structures were connected to the Mount Lemmon WWTF, most were on conventional septic systems. Therefore, there was a high density of septic systems on lots on either side of Sabino Creek. Previous studies referenced in this document suggest that septic systems in Summerhaven had the potential to impact water quality in Sabino Creek, which runs north to south, bisecting the community.

The Aspen Fire in 2003 resulted in structure loss and damage in Summerhaven. Of an estimated 600 developed lots, at least 324 structures were lost in the fires, and records indicate that 5 sustained damage. PDEQ records suggest that up to 340 structures in Summerhaven were damaged by the fire. Water usage
and wastewater flows for the community prior to the fires followed fairly predictable trends. Redevelopment is underway and the types of structures being constructed in Summerhaven today differ from those of the past.

**Redevelopment Trends and Wastewater Flow**

Pre-fire structures were mainly for weekend and seasonal use, large multi-story homes are being built. While wastewater flow trends can be estimated using historic data, only a limited amount of data exists for buildings constructed after the fires. As part of post-fire redevelopment, a portion of lot owners have applied for private, Type 4 general permit on-site wastewater systems, and 19 connections to the WWTF are currently active. Redevelopment of lots that previously had structures is anticipated. Given the limited data set, projections for the purpose of planning are affected by uncertainties and unknowns.

Flows to the current WWTF are less than the rated capacity of the plant and regulatory limits. However, as redevelopment occurs, studies suggest that the capacity of the plant will be exceeded, first by peak flows in the short term, and then by average daily flows. Estimating the timeline of capacity exceedance is challenging due to uncertainties associated with the larger homes under construction which may be intended for year round occupancy or multiple family occupancy. If this is the case, both water usage and wastewater flows will accelerate, at a rate that cannot be accurately determined based on the limited available data. To address this possibly, this study recommends a plan of action:

- Collection of post study data to calibrate projections to the growing body of actual data to evaluate water usage and wastewater flow trends as they related to the timing of WWTF upgrade and collection of lot-specific information;
- Establishing test cases/homes with metered water usage and metered flows to on-site systems to assess if the flows that are being used for on-site wastewater system permitting are representative of actual flows;
• Including a margin of safety in wastewater management planning to size the plant to prevent exceeded plant capacity and permit limits if flows associated with redevelopment are more similar to the average daily flows reported in the Type 4 general permit applications for on-site wastewater systems than the flows per lot reported prior to the fire, which were about 100 gpd; and,

• Improving treated effluent to a higher quality to maximize options for disposal and beneficial use of treated effluent in response to an extended period of drought and a limited water supply in the Mount Lemmon area. Use of reclaimed water from the WWTF to supply water to suppress or fight fires will off-site use of potable water for this purpose and contribute to water conservation. Use of reclaimed water to irrigate in Reforestation areas will enhance visual resources and stabilize soils in irrigated areas.

Short Term Wastewater Planning
Upgrading the WWTF to Improve Treated Effluent Quality - The study assessed whether upgrading the WWTF by adding additional treatment units or replacing the WWTF was the best course of action. Given high nitrogen levels in influent, uncertainties with I&I during storm events, and limiting site conditions, replacement of the WWTF with an SBR plant was recommended as the preferred path forward at the 98% draft report stage. In meetings following the 98% draft report submittal, additional information was shared regarding lots located south of the WWTF. This information indicates that additional land will be available for the WWTF. This will allow short term upgrades to be made and then the WWTF to be operated side by side with a replacement plant at the time of expansion in response to long term needs. This means recommendations already may need to be adjusted.
The timeline proposed in the plan establishes a startup goal of 2011 for upgrade. While that goal is several years away, permitting efforts associated with replacement of the plant can take up to 2 years. Improved discharge quality associated with plant upgrade will increase options for reclaimed use of treated effluent for beneficial uses such as fire fighting and reforestation. Between now and 2011 when the upgraded WWTF is in place, peak flows can be managed with off-site storage tanks and private flow equalization. Once the WWTF is in place, connections to the system can be encouraged which will reduce reliance on on-site wastewater systems.

Storage Tank for Fire Fighting Water Supply - Short term planning also includes installing a storage tank for treated effluent that can be accessed either by fire truck or by helicopter to provide water for fire fighting. During the Aspen and Bullock Fires water was hauled up the mountain by truck and helicopter, resulting in not only traffic on the Catalina Highway but also incurred transportation costs for hauling and purchasing the water. An off-site tank can not only be used to store effluent for fire fighting but also is the first step in developing other options for beneficial use of treated effluent.

Long Term Wastewater Planning
In addition to short term planning, the study also extended out for a period of 20 years to assess long term wastewater management demands. Long term plans for expansion of WWTF to increase discharge limits and treatment capacity as needed to respond to increased flows and redevelopment trends are proposed. Plans include staged reforestation to use reclaimed water from the WWTF and revising state rules and the 208 Certified Area-wide Water Quality Management Plan, both which currently prohibit the Mount Lemmon WWTF from discharging treated effluent to Sabino Creek. When rules are revised and improved effluent
quality has been achieved after plant upgrades, then discharge to Sabino Creek will be feasible.

**Enhanced Reclaimed Options & Regulatory Data Requirements**

To enhance options for either discharge or reclaimed use of treated effluent, additional studies are needed.

Outfall to Sabino Creek - To develop the option of discharge to Sabino Creek, not only will environmental rules need to be revised which prohibit discharge of wastewater to the creek, but also baseline studies will be needed. Given the timelines projected in this plan, baseline studies need to start in 2008. The plan recommends:

- Installation of gauging station in Sabino Creek and a rain gauge in Summerhaven;
- Baseline creek water quality sampling at up and downstream locations;
- Biological surveys as needed to evaluate effects of discharge on threatened and endangered species and the Pusch Ridge Wilderness Area located downstream of Summerhaven;
- Assessment of influent concentrations of copper and zinc and sources of these constituents in drinking water supply;
- Initiation of permitting and NEPA EIS efforts after rule revision is successful; and,
- Installation of advance treatment units at the WWTF to reduce copper and zinc concentrations to levels that will meet Arizona Surface Water Quality Standards.

Firefighting Storage Tank Location – The study proposes a conceptual site at the old sawmill location based on ease of helicopter access. In order to use USFS land, a private land alternative must not be available. Site screening and selection are recommended as part of initial scoping. This option may be eligible
for a Categorical Exclusion from NEPA and possibly obtained through a simple letter-based process if there are no significant impacts to threatened and endangered species associated with the construction and development project.

Irrigation for Reforestation - This option will assist with Summerhaven recovery from the visual scars of the past fires. As part of site selection for use of reclaimed water for irrigation and reforestation, site screening criteria must be established. Using those criteria the study recommends that a 70-acre lot of land be selected. To implement this option:

- Baseline studies will be needed to assess soils and ensure no impact to T&E species, including consumptive use modeling;
- Site selection should search for USFS and private lands;
- USFS lands should be pursued for use only if private lands cannot be acquired for this purpose;
- Using the baseline data, landscape architecture design is recommended to maximize use of land;
- A subsurface drip irrigation system is recommended to reduce impact during period of freezing conditions and deliver reclaimed water to each tree; and,
- An initial 70-acre lot will utilize the majority of treated effluent expected from 2011 until 2027. Reliance on the current spray fields can be decreased as trees grow and uptake increases.

**Septic System Density, Sabino Creek and Drinking Water Source Quality**

Previous development in Summerhaven was heavily reliant on conventional septic systems for wastewater management. As lots are redeveloped, the timing is good for assessing the suitability of this area for on-site wastewater treatment systems and ensuring that the Type 4 general permit program is implemented in a manner that protects the drinking water supply in Summerhaven and looks towards a sustainable future during a long term drought. The plan recommends
steps for reducing reliance on conventional systems and on-site systems that goes hand in hand with short term upgrade of the WWTF and development of a Sewage Improvement District or other authority to unite the community for wastewater management, and create a mechanism to fund the installation of a conveyance system for the Summerhaven Sewage Planning Area. This is an important step in protecting water resources in Summerhaven. A comprehensive wastewater management strategy is a next step, including multi-agency discussions and strategic planning to implement a unified approach across departments.

**Water Resources and Water Demand**

The study found that the amount of hydrologic data in the Mount Lemmon area is limited, and a full water resource investigation is recommended. Springs are the primary source of drinking water. Development in Summerhaven without full understanding of the source of drinking water may impact future supply and ultimately limit the future of the community. It is likely that water rights will exceed supply if the current drought continues. Information presented in the study suggests that demand will approach water rights and supply during the 20-year planning period. The water supply in Summerhaven is both limited and vulnerable given its direct connection to rainfall and movement of water through fractures. Domestic wells may affect the hydrologic system and also accentuate movement of contamination from septic systems. Fracture driven groundwater flow has not been studied to date. As part of resource management, this study recommends:

- A water resource investigation including assessment of fractures, springs, aquifer properties and recharge;
- Multi-agency discussions, policies and implementation practices to protect the vulnerable and limited water resources of the area; and
- Continued study of demand, usage and comparison to water rights and availability.
Considerations for Reclaimed Water and Human Consumption
The Summerhaven area is in a hydrogeologic setting that is analogous to a community located in Cloudcroft, New Mexico. Both communities have a limited water supply that is fed by springs, both are in mountainous retreat areas that depend in part on tourism for economic support, and both have small base populations to serve as a tax base. During a drought, the supply of water dwindled and the community of Cloudcroft trucked in potable water. Cloudcroft solved water resource challenges by implementing a multiple path plan and developing a new treatment system that was funded by the State of New Mexico for a cost of $600,000.00. The improvement plan for the wastewater system was approved by the State as an innovative water conservation measure. The system includes advance treatment of wastewater, use of wastewater for irrigation, additional treatment and mixing to a 50/50 ratio with spring water, final polishing of reclaimed water and delivery of the water for human consumption. The community developed a complete recycle water conservation plan. In follow up to Cloudcroft, this study recommends the following:

- Examination of options to update state law which prohibits direct or indirect reclaimed use for human consumption;
- Study of the regulatory setting of Cloudcroft and public perception post-implementation of toilet to tap technologies and methods; and,
- Evaluation of water demands, usage and wastewater flows for the Cloudcroft for relevance to a sustainable future for Summerhaven.

A 20-year plan including exploration of funding mechanisms, conveyance, wastewater treatment, wastewater management and exploration and understanding of water resources has been set forth in this report. To move from plan to implementation requires additional data collection and policy development to protect limited and vulnerable water resources and to ensure that conservation is at the center of short and long term wastewater management practice.
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REFERENCES (cont.)


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**TREATMENT OPTIONS**

**DISPOSAL OPTIONS**

- **Private Septic Systems**
  - N
- **Off-site 100,000 gallon storage tank**
  - Y
- **Increase flow to General Permit and USFS limits**
  - Y

**Disposal Options for No WWTP Upgrade**

- **Discharge to Current disposal field within permit limits**
  - Y
- **Discharge to Sabino Creek**
  - Y

**Major Facility Modification at Current Location (50,000 GPD on current site)**

- **Expansion of Plant Capacity and new hook ups**
  - Y

**New WWTP at New Location**

- **BADC**
  - BADC
- **BADC plus A+ Reclaimed Water**
  - BADC

**Disposal Options for either Major Plant Modification or New WWTP**

- **Same Disposal Field**
  - Y
- **Reclaimed Options - consumptive use, no disposal**
  - Y
- **Winter snowmelt (wetland fill), summer reclaimed irrigation**
  - Y
- **Total Reclaimed Use - Reclamation in San Pedro Watershed**
  - Y
- **Total Reclaimed Use - Reclamation in Santa Cruz Watershed Federal Land**
  - Y
- **Recharge Injection Well Options (basins not assessed due to limited space availability)**
  - Y
- **New Outfall**
  - Y

**May Impact timeline significantly or stop project or result in increased project costs**

**Benefit results in regulation by one less permit (such as AEPDES), may be perceived in a beneficial way or improve timeline, or decrease costs**

**Requirement driven by treatment option or disposal option - addressed at higher or lower level in matrix**

- **Major Modification and New WWTP Assumptions**
  - Up to 50,000 gal expansion can be sized and designed to fit on current PC property
  - PCWOE would not maintain, construct, or own-gas collection systems less than 6" diameter
  - If a developer (or group) constructed sewer laterals that meet all of PCWOE standards, then PCWOE would accept and maintain the laterals
  - Private lift stations would be constructed by individuals and would require an MVC permit to connect to PCWOE's collection system
  - Decisions are in conformance with PCWOE's standard operation procedures
  - Less than one acres harvested for current tile expansion
  - WWTP permitting requirements assume that the WWTP needs an individual APP and some disposal options require a separate individual APP
Aquifer Protection Permit (APP) Process

1 – 6 Months prior to application submital

35 Business Days (excluding applicant response time)

180 Business Days (no hearing – excluding applicant response time)

45 Business Days (hearing)

NOTICE OF PUBLIC HEARING

Final draft permit and factsheet approved

Unconditional Approval (UNAP) issued (LTF)

Final invoice

Final bill paid

Permit signed/issued

Agency

Applicant

LTF Clock

Figure 3-3
Figure 3-4

Arizona Pollutant Discharge Elimination System (AzPDES) Process

1 – 8 Months prior to application submittal

Applicant collects information

Multiple cycles if deficiencies not corrected

Notice of Administrative Deficiency (NADS)

LTF Clock Re-starts

LTF Clock Re-starts

Applicant submits NADS response

Applicant submits application to SWS

Administrative Completeness Review (ACR) by ADEQ SWS

NO

COMPLETE?

YES

Application Administratively Complete

ADEQ issues notice of administrative completeness

LTF SCR Clock Starts

Substantive/Technical Review (SCR)

NO

COMPLETE?

YES

ADEQ SWS drafts permits and factsheet

ADEQ internal review

ADEQ external review (applicant)

Publish Public Notice

Written comments submitted to ADEQ

Public comments period begins (30 days)

Notice of Public Hearing

YES

(ADEQ discretion)

Final draft permit and factsheet approved

Unconditional Approval (UNAP) issued (LTF)

Final invoice

Final bill paid

Permit signed/issued

Significant Public Comments?

NO

45 Business Days (hearing)

Public Hearing

Written Comments

Responsiveness summary

Permit Revision

Agency

Applicant

LTF Clock
Figure 9-1 - Mt. Lemmon WWTF Regulatory Time Line
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